

## **Pauropoda (Myriapoda) from Sabah (East Malaysia) (Pauropoda and Symphyla of the Geneva Museum XI)**

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**Pauropoda (Myriapoda) from Sabah (East Malaysia) (Pauropoda and Symphyla of the Geneva Museum XI).** - A collection of Pauropoda from Sabah, the East Malaysian part of Borneo, contains 64 specimens from 14 species. They belong to the genera *Allopauropus*, *Stylopauropus*, *Pauropus*, *Hemipauropus*, *Brachypauropoides*, *Samarangopus* and *Sphaeropauropus*. The following nine species are described as new to science: *Allopauropus kinabaluensis* sp. n., *Allopauropus yoshii* sp. n., *Pauropus borneensis* sp. n., *Brachypauropoides prolatus* sp. n., *Samarangopus longipenes* sp. n., *Samarangopus ternarius* sp. n., *Samarangopus proekes* sp. n., *Sphaeropauropus penicillius* sp. n. and *Sphaeropauropus arcuatus* sp. n.

**Key-words:** Borneo - Malaysia - Sabah - Pauropoda - taxonomy - biogeography - rain forest - soil zoology.

### INTRODUCTION

It is well-known that the infrastructure of the Geneva Museum is well accommodated with all the resources necessary for advanced soil zoology studies, both with regard to personnel and materials. The curating activities from collecting and preserving to storing and cataloguing have been continued with plenty of ambition for about 100 years. This has made it possible to create the valuable collections now in the Arthropoda and Entomology sections and also to make them available to soil zoologists for their studies and to publish the results in Geneva. From the earliest days J. Carl has to be remembered and the traditions from his time have been continued and developed by H. Gisin, C. Besuchet and B. Hauser. Their purposeful work for the improvement and expansion of the soil fauna studies has led to large collections of great value. Material collected by means of various automatical extraction methods (Tullgren-Berlese, Winkler-Moczarski, and modifications of them) strongly contributed to important taxonomical results in several animal groups, among them Symphyla and Pauropoda. A remarkable collection of material from the latter group is reported below.

In April-May 1982 Dr Bernd Hauser visited Borneo – following an invitation of Prof. Dr R. Yoshii (formerly Kyoto, at this time working in Sepilok) – and collected 64 specimens of Pauropoda in the State of Sabah, East Malaysia. The material comes from both coastal areas and from the mountainous region around

Mount Kinabalu. Almost all samples were taken in primary rain forests, from dipterocarp lowland forests at 30 m a.s.l. to *Lithocarpus-Castanopsis* forests at 3270 m.

Animals were collected from litter and subsoil mainly by means of automatical extraction (Berlese funnels and Winkler-Moczarski apparatus) and to a less degree manually.

Fourteen species are present in the material collected by Dr Hauser. They belong to 7 genera in 3 families: 4 in Pauropodidae (*Allopauropus*, *Pauropus*, *Stylopauropus*, *Hemipauropus*), one in Brachypauropodidae (*Brachypauropoides*) and 2 in Eurypauropodidae (*Samarangopus*, *Sphaeropauropus*). With this material it has been possible to add 12 species to the Bornean fauna and to describe 9 new species. The latter are *Allopauropus kinabaluensis* sp. n., *A. yoshii* sp. n., *Pauropus borneensis* sp. n., *Brachypauropoides prolatus* sp. n., *Samarangopus longipenes* sp. n., *S. ternarius* sp. n., *S. proekes* sp. n., *Sphaeropauropus penicillius* sp. n. and *S. arcuatus* sp. n. Unless stated otherwise, all material was collected by Dr Bernd Hauser and is deposited in the Natural History Museum of Geneva.

#### PREVIOUS KNOWLEDGE

Pauropods were reported for the first time from Borneo by Scheller *et al.* (1994). Though only 35 specimens were studied, they represented 7 species: *Allopauropus proximus* Remy, *A. borneonesiota* Scheller, *A. asymmetricus* Scheller; *Rabaudauropus dispar* Scheller and an unidentified species of *Stylopauropus* (Pauropodidae); *Brachypauropoides penanorum* Scheller (Brachypauropodidae) and *Samarangopus segniter* Scheller (Eurypauropodidae).

#### SYSTEMATICS

##### PAUROPODIDAE

Four described species in this family were previously known from Sabah: *Allopauropus (D.) proximus* Remy, *A. (D.) borneonesiota* Scheller, *A. (D.) asymmetricus* Scheller and *Rabaudauropus dispar* Scheller (Scheller *et al.*, 1994). Seven named species of Pauropodidae are present in Dr Hauser's collection, 4 of them described earlier and 3 new species described below. Among these 7 species one (*A. proximus*) was reported earlier and 6 are new to Sabah (i.e. *Allopauropus (D.) maeriorum* Remy, *A. (D.) bouini* Remy, *A. (D.) kinabaluensis* sp. n., *A. (D.) yoshii* sp. n., *Pauropus borneensis* sp. n., *Hemipauropus melanesicus* Scheller). Thus 10 described species of Pauropodidae from 4 genera are now known from Sabah.

Genus *Allopauropus* Silvestri, 1902

Subgenus *Allopauropus* s. str.

*Allopauropus (A.) maeriorum* Remy

*Allopauropus (A.) maeriorum* Remy, 1956a: p. 19-21, fig. 4, 1-5.

*Material examined.* SABAH, West Coast Residency, Mt Kinabalu, "Summit Trail", below "Panar Laban Huts", soil sample in *Leptospermum* forest, Berlese extraction, alt. 3270 m, 10 ad. 9<sup>1</sup> (2♂, 8♀), 2 subad. 8 (♂, ♀), 1 juv. 6. 30.IV.1982 (Loc. Sab-82/22).

*Total number.* 13 specimens.

<sup>1</sup> abbreviations: ad. ...., subad. ... and juv. ... = an adult, a subadult or a juvenile specimen with the number of pairs of legs indicated.

*General distribution.* The species seems to have a wide range on the south hemisphere but has not often been collected. Two sites are known from New Zealand (Remy, 1956a, b), one from New Caledonia (Scheller, 1993) and one from southern Chile (Scheller, 1968). It is known from a hothouse in Switzerland too (glasshouse in the Botanical Garden, Geneva) (Remy, 1957c).

Subgenus *Decapauropus* Remy, 1957

*Allopauropus (D.) bouini* Remy

*Allopauropus (D.) bouini* Remy, 1955: p. 129-130, fig. 8.

*Material examined.* SABAH, Sandakan Residency, 24 km W Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", near "Pond", secondary lowland forest, litter, Berlese extraction, 1 ad. 9(♀), 10.V.1982 (Loc. Sab-82/41).

*Total number.* 1 specimen.

*General distribution.* Like the preceding species, *A. bouini* is rare but has a wide range. It has been collected in Angola (Remy, 1955; Scheller, 1975), Florida (Remy, 1959a) and Canada (Scheller, 1983).

*Allopauropus (D.) proximus* Remy

*Allopauropus (D.) proximus* Remy, 1948: p. 572-573, fig. 4.

*Material examined.* SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", forest near "Orang-Utan Rehabilitation Station", soil sample from between buttresses of Dipterocarpaceae trees, Berlese extraction, 1 ad. 9(♀), 23.IV.1982 (Loc. Sab-82/4-II); ibidem, path in the mangrove, in the transition zone rain forest/mangrove, lowland Dipterocarpaceae forest, near "Cottage" (old *Hevea* plantation), soil sample, Berlese extraction, 5 ad. 9(♀), 2 juv. 6, 2 juv. 5, 7.V.1982 (Loc. Sab-82/34); ibidem, near "Pond", secondary lowland forest, litter, Berlese extraction, 1 juv. 6, 10.V.1982 (Loc. Sab-82/41). Interior Residency, road to Kimanis, 14 km from Keningau, "Checkpoint", under stones near the barracks, alt. 950 m, 4 ad. 9(♀), 1 juv. 6, 14.V.1982, leg. B. Hauser (Loc. Sab-82/52).

*Total number.* 16 specimens.

*A. proximus* was previously known from Sabah, 3 sites in the Mendolong tree nursery (near Sipitang) and 2 sites just S of Mendolong (Scheller *et al.*, 1994).

*General distribution.* The species has a wide discontinuous range in the tropics and subtropics of the Americas, Africa and southern Asia. From southeastern Asia it was previously known from the Malaysian part of Borneo (Scheller *et al.*, 1994), the Seychelles (Scheller, 1982), Pondichéry (Remy, 1962), Sri Lanka (Scheller, 1970) and the Palau Islands (Remy, 1957d).

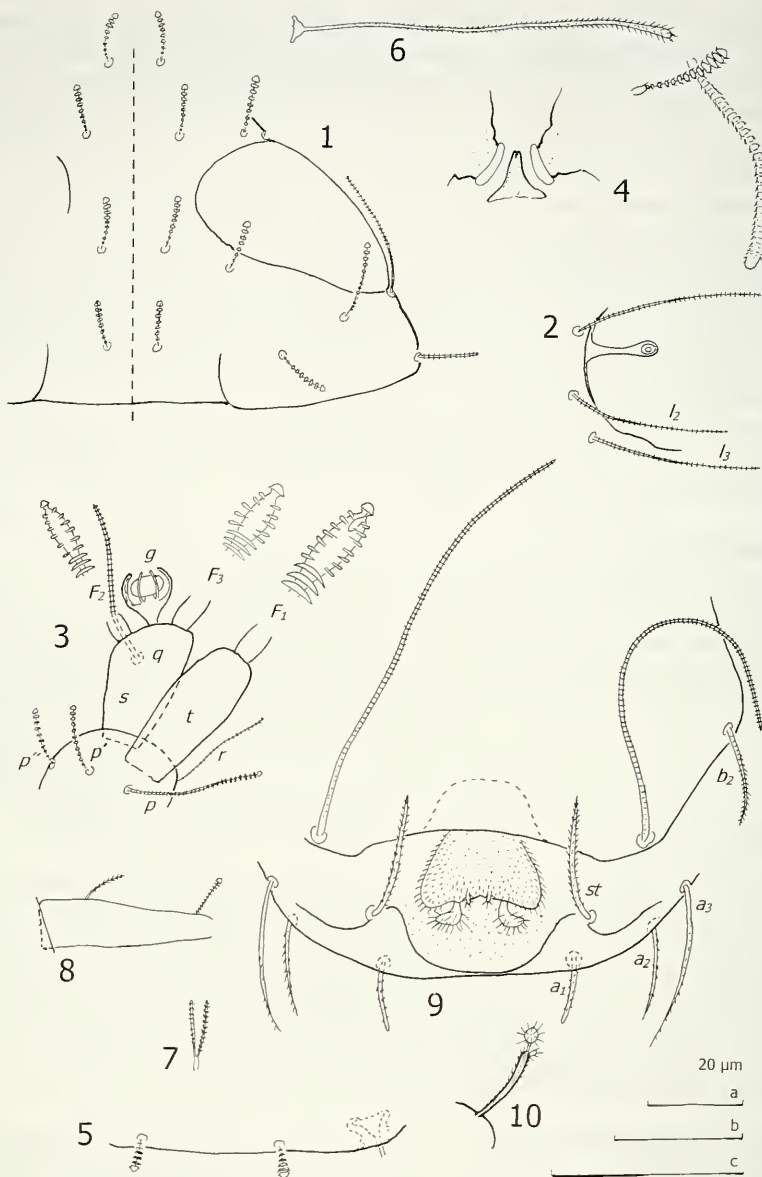
*Allopauropus (D.) kinabaluensis* sp. n.

Figs 1-10

*Type material.* **Holotype:** ad. 9 (♀), SABAH, West Coast Residency, Mount Kinabalu, "Summit Trail" (path connecting "Power Station" with the top), before "Carson's Camp", cloud forest, alt. 2480 m, 29.IV.1982, leg. B. Hauser (Loc. Sab-82/18). **Paratype:** ad. 9 (♀), SABAH, West Coast Residency, Mount Kinabalu, "Bukit Ular Trail" (path connecting "Kambarang Road" with "Power Station"), *Lithocarpus-Castanopsis* forest, alt. 1850 m, 28.IV.1982, leg. B. Hauser (Loc. Sab-82/13).

*Other material:* SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", forest near "Pond", secondary lowland forest, sample of litter and decaying wood, Berlese extraction, 1 subad. 8(♀), 10.V.1982 (Loc. Sab-82/42).

*Total number.* 3 specimens.



FIGS 1-10

*Allopauropus (D.) kinabaluensis* sp. n., holotype, ad. 9(♀). 1, head, median and right part, tergal view; 2, temporal organ, posterior part, right side, lateral view; 3, right antenna, tergal view; 4, collum segment, median and left part, sternal view; 5, tergite VI, posteromedian and right posterior part; 6,  $T_9$ ; 7, seta on coxa of leg 9; 8, tarsus of leg 9; 9, pygidium, median and left part, sternal view; 10, anal plate, lateral view. Scale a: Figs 5, 7, 8; b: Figs 1, 4, 6; c: Figs 2, 3, 9, 10.

*Diagnosis.* *A. (D.) kinabaluensis* is well delimited from all other species of *Decapauropus* by the shape of the anal plate (proportionally broad, strongly pubescent, with 4 appendages, two of which are clavate and bent perpendicularly outwards).

*Etymology.* A latinized adjective of the name of Mt Kinabalu.

#### DESCRIPTION

*Length.* (0.52-)<sup>2</sup> 0.59 mm.

*Head.* Tergal setae of medium lengths, somewhat clavate, annulate, blunt; lateral ones rather long, thin, cylindrical, striate. Relative lengths of setae, 1<sup>st</sup> row:  $a_1 = 10$ ,  $a_2 = (8)$ ; 2<sup>nd</sup> row:  $a_1 = 10$ ,  $a_2 = 12(13)$ ,  $a_3 = (17)$ ; 3<sup>rd</sup> row:  $a_1 = 10$ ,  $a_2 = 10(12)$ , 4<sup>th</sup> row:  $a_1 = 9$ ,  $a_2 \approx 10$ ,  $a_3 = 16$ ,  $a_4 = 12$ ; lateral group of setae:  $l_1 = (24)25$ ,  $l_2 = 20$ ,  $l_3 = 19(21)$ . The ratio  $a_1/a_1-a_1$  is: 1<sup>st</sup> row 1.0, 2<sup>nd</sup> row 0.5, 3<sup>rd</sup> row 0.8 and 4<sup>th</sup> row 0.9. Temporal organs widest in anterior part, 1.5 times as long as the shortest distance between them, aperture in posterior part distinctly anterior of posterior margin. Head cuticle glabrous.

*Antennae.* Segment 4 with 4 cylindrical annulate blunt setae,  $r$  very thin, relative lengths of setae:  $p = 100$ ,  $p' = 47(50)$ ,  $p'' = (41)43$ ,  $r = 73(85)$ . Tergal seta  $p$  0.9 of the length of tergal branch  $t$ . The latter fusiform, (2.1)2.5 times as long as its greatest diameter and 1.2 times as long as sternal branch  $s$  which is 1.6 times as long as its greatest diameter; anterodistal corner of  $s$  distinctly truncate. Seta  $q$  as seta  $p$  of 4th segment, 1.3 times as long as  $s$ . Relative lengths of flagella (with base segments included) and of base segments alone:  $F_1 = 100$ ,  $bs_1 = (4)5$ ,  $F_2 = 32$ ,  $bs_2 = (2)3$ ;  $F_3 = 68(71)$ ,  $bs_3 = 5$ . The  $F_1$  5.2(5.9) times as long as  $t$ ,  $F_2$  and  $F_3$  (1.9)2.0 and 4.2 times as long as  $s$  respectively. Distal calyces hemispherical, smallest on  $F_2$ ; distal part of flagella axes distinctly fusiform, more on  $F_1$  and  $F_3$  than on  $F_2$ . Globulus  $g$  1.1 times as long as wide with (8)9 bracts, capsule flattened; width of  $g$  0.8 of the greatest diameter of  $t$ . Antennae glabrous.

*Trunk.* Setae of collum segment simple, thick, somewhat clavate, densely but distinctly annulate; sublateral setae 2.1 times as long as submedian ones; sternite process subtriangular, anterior extension narrow and with small apical incision; appendages subconical, caps flat but wide, process and basal segment of appendages with minute pubescence.

Setae on tergites similar to median head setae, setae on anterior tergites only slightly longer than those on most posterior tergites. 4+4 setae on tergite I, 6+6 on II-IV, 6+4 on V, 4+2 on VI. Submedian posterior setae on tergite VI 0.2 of their distance apart and as long as pygidial setae  $a_1$ . Tergites almost glabrous.

*Bothriotricha.* Relative lengths of bothriotricha:  $T_1 = 100$ ,  $T_2 = (107)$ ,  $T_3 = 81$  and 94(93),  $T_4 = (95)$ ,  $T_5 = 132(152)$ . They have simple, straight axes, thin in all but  $T_3$ . Axes of  $T_3$  growing thicker outwards, with blunt tips. Hairs on  $T_1$ ,  $T_2$ ,  $T_4$  and  $T_5$  short, simple, almost erect, on  $T_3$  stronger, sparser and oblique.

<sup>2</sup> Measurements taken from adult paratypes are given in brackets.

*Legs.* Setae on coxa and trochanter of leg 9 similar, furcate, branches cylindrical, striate, blunt. These setae on legs 1-8 simple, striate, on leg 1 cylindrical, on legs 2-8 somewhat clavate. Tarsus of leg 9 tapering, 3.0 times longer than its greatest diameter. Proximal seta very thin and with oblique pubescence, its length 0.3 of the length of tarsus and about as long as distal seta, the latter somewhat clavate, annulate, blunt. Cuticle of tarsus glabrous.

*Pygidium. Tergum.* Posterior margin evenly rounded but with a large lobe on its sternal side between *st*. Relative lengths of setae:  $a_1 = 10$ ,  $a_2 = 16(18)$ ,  $a_3 = (22)26$ ,  $st = 21(24)$ . All these setae with a short oblique pubescence, strongest on *st*. The  $a_1$  cylindrical, blunt, somewhat curved inwards,  $a_2$ ,  $a_3$  and *st* tapering and pointed;  $a_2$  and  $a_3$  directed posteriorly, curved inwards, *st* of the same shape but directed downwards. Distance  $a_1 - a_1$  2.8(3.2) times as long as  $a_1$ ; distance  $a_1 - a_2$  1.7 times as long as distance  $a_2 - a_3$ , distance *st - st* 0.6 of the length of *st* and 1.1 times as long as distance  $a_1 - a_1$ . Cuticle granular between the *st*.

*Sternum.* Posterior margin between  $b_1$  with broad and shallow indentation below anal plate. Relative lengths of setae ( $a_1 = 10$ ):  $b_1 = 64(67)$ ,  $b_2 = 16(17)$ . All these setae thin, subcylindrical, striate. The  $b_1$  1.3 times as long as their interdistance,  $b_2$  0.7 of the length of distance  $b_1 - b_2$ .

Anal plate narrowest anteriorly, (1.5)1.6 times as broad as long and with convex lateral margins and rounded posterolateral corners. Posterior margin with broadly V-shaped indentation and 4 appendages: 2 large and 2 small. The former strongly clavate, with distal half thickened and bent outwards perpendicularly to the median line of the body; their length one third of the greatest width of the plate. The latter appendages close to each other at the median line, very short, cylindrical, directed posteriorly from the posterosternal side. Plate and appendages with distinct oblique pubescence, longest on posterolateral corners and on distal half of clavate appendages.

#### RELATIONSHIPS

The new species may be related to *A. (D.) blandinae* Remy from the Ivory Coast (Remy, 1957b) as indicated by similarities in the groundplan of the anal plate and similar antennae and  $T_3$ .

#### *Allopauropus (D.) yoshii* sp. n.

Figs 11-18

*Type material. Holotype:* ad. ♀, SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", near "Pond", secondary lowland forest, litter, Berlese extraction, 10.V.1982 (Loc. Sab-82/41).

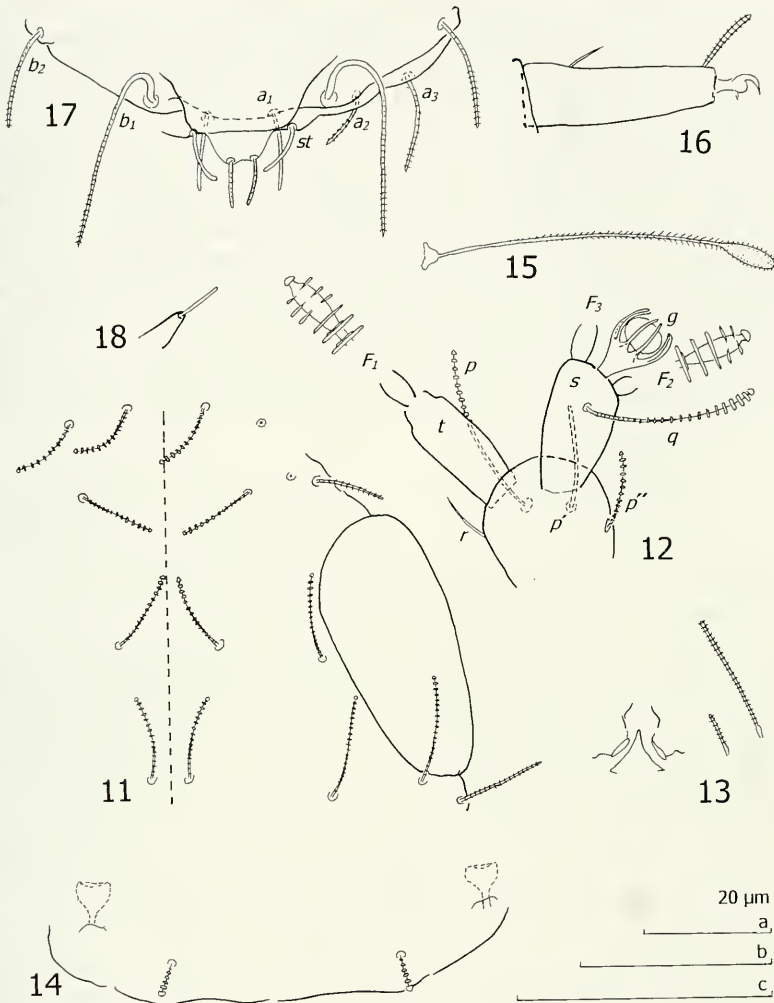
*Total number.* 1 specimen.

*Etymology.* Dedicated to the renowned collembologist and specialist of soil and cave faunas, the late Professor Dr Riozo Yoshii, for his kind help and great encouragement in connection with Dr Hauser's expedition.

#### DESCRIPTION

*Length.* 0.32 mm.

*Head.* Tergal setae of medium lengths, thin, cylindrical, annulate, blunt. Relative lengths of setae, 1<sup>st</sup> row:  $a_1 = 10$ ,  $a_2 = 9$ , 2<sup>nd</sup> row:  $a_1 = a_3 = 10$ ,  $a_2 = ?$ ; 3<sup>rd</sup> row:  $a_1 =$



FIGS 11-18

*Allopauropus (D.) yoshii* sp. n., holotype, ad. 9(♀). 11, head, median and right part, tergal view; 12, right antenna, sternal view; 13, collum segment, median and left part, sternal view; 14, tergite VI, posterior part; 15,  $T_3$ ; 16, tarsus of leg 9; 17, pygidium, posterior part, sternal view; 18, anal plate, lateral view. Scale a: Figs 13, 15; b: Figs 16-18; c: Figs 11, 12, 14.

10,  $a_2 = 12$ ; 4<sup>th</sup> row:  $a_1 = 11$ ,  $a_2 = 14$ ,  $a_3 = 13$ ,  $a_4 = 12$ , lateral group of setae:  $l_1 = l_2 = 13$ ,  $l_3 = 17$ . The ratio  $a_1/a_1 - a_1$  is in 1<sup>st</sup> row 1.0, 2<sup>nd</sup> row 0.5, 3<sup>rd</sup> row 0.9 and 4<sup>th</sup> row 1.6. Temporal organs widest in anterior part, their length 0.9 of their shortest interdistance; posterior aperture not found. Head cuticle glabrous.

*Antennae.* Segment 4 with 4 cylindrical setae,  $r$  very thin;  $p$ ,  $p'$  and  $p''$  annulate, blunt. Their relative lengths:  $p = 100$ ,  $p' = 57$ ,  $p'' = 46$ ,  $r = 32$ . Tergal seta  $p$  1.4

times as long as length of tergal branch  $t$ . The latter fusiform, 2.2 times as long as its greatest diameter and almost as long as sternal branch  $s$  which is 1.5 times as long as its greatest diameter; anterodistal corner of  $s$  distinctly truncate. Seta  $q$  somewhat clavate, annulate, 1.3 times as long as  $s$ . Relative lengths of flagella (with base segments included) and of base segments alone:  $F_1 = 100$ ,  $bs_1 = 5$ ;  $F_2 = 38$ ,  $bs_2 = 3$ ;  $F_3 = 77$ ,  $bs_3 = 5$ . The  $F_1$  5.3 times as long as  $t$ ,  $F_2$  and  $F_3$  1.9 and 3.9 times as long as  $s$ , respectively. Distal calyces very small, somewhat flattened, distal part of flagella axes fusiform. Globulus  $g$  1.2 times as long as wide with 11 bracts, capsule subspherical; width of  $g$  1.1 times as long as greatest diameter of  $t$ . Antennae glabrous.

*Trunk.* Setae of collum segment simple, somewhat increasing in thickness outwards, densely annulate; sublateral setae 2.9 times as long as submedian ones; sternite process triangular, anterior lengthening narrow and pointed; appendages small, indistinct, with flat caps; process and appendages glabrous. Setae on tergites similar to median head setae. Tergite VI with 4+2 setae, submedian posterior setae almost 0.2 of their distance apart and 0.4 of pygidial setae  $a_1$ . Tergites glabrous.

*Bothriotricha.* Lengths of bothriotricha:  $T_1 = ?$ ,  $T_2 = 70$ ,  $T_3 = 55$ ,  $T_4 = 61$ ,  $T_5 = 104 \mu\text{m}$ . All but  $T_3$  with very thin, simple, straight axes. Axes in the latter thicker with ovoid endswelling, 2.8 times as long as wide. Pubescence on  $T_1$ ,  $T_2$ ,  $T_4$  and  $T_5$  on distal half only, hairs very short, simple, almost erect; pubescence on axes of  $T_3$  stronger, oblique, on end-swelling short, dense, erect.

*Legs.* Setae on coxa and trochanter of leg 9 not studied. More anteriorly these setae being simple, annulate, blunt, with rudimentary secondary branches. Tarsus of leg 9 tapering, 2.9 times as long as its greatest diameter. Proximal seta short, thin, pointed, its length 0.2 of the length of tarsus and 0.6 of the length of distal seta. The latter cylindrical, striate, blunt, its length almost 0.4 of the length of tarsus. Metatarsus short, annular. Cuticle of tarsus glabrous.

*Pygidium. Tergum.* Posterior part with a low bulge being somewhat broader than the distance between  $st$ ; posterior margin of lobe straight. Relative lengths of setae:  $a_1 = 10$ ,  $a_2 = 7$ ,  $a_3 = 14$ ,  $st = 9$ . These setae thin, cylindrical, blunt, curved inwards:  $a_1$  and  $st$  almost glabrous,  $a_2$  and  $a_3$  striate;  $a_1$  and  $a_3$  directed posteriorly,  $a_2$  and  $st$  converging. Distance  $a_1 - a_1$  0.9 of the length of  $a_1$ ; distance  $a_1 - a_2$  1.4 times as long as distance  $a_2 - a_3$ ; distance  $st - st$  as long as  $st$  and 1.4 times as long as distance  $a_1 - a_1$ . Cuticle glabrous.

*Sternum.* Posterior margin between  $b_1$  with large trapeziform lobe below anal plate. Relative lengths of setae ( $a_1 = 10$ ):  $b_1 = 31$ ,  $b_2 = 15$ . These setae thin, cylindrical, striate. The  $b_1$  1.4 times as long as their distance apart,  $b_2$  0.9 of the length of distance  $b_1 - b_2$ .

Anal plate broadest anteriorly, 2.2 times as broad as long and with almost straight lateral margins and short posterior margin with shallow median indentation and two appendages; the latter thin, cylindrical, directed posteriorly, somewhat curved inwards. Plate glabrous, appendages indistinctly striate.

#### RELATIONSHIPS

Among the species of the subgenus *A. (D.) yoshii* sp. n. may be most close to *A. (D.) pachyflagellus* Scheller, from Central Amazonia (Scheller, 1997). *A. (D.)*



*furcosus* Remy from Mauritius (Remy, 1959b) and *A. (D.) presbyteri* Remy from Algeria (Remy, 1947). The new species has similarities to *A. pachyflagellus* in the shape of the antennae, the bothriotricha and the anal plate, but they are distinguished by e.g. the shape of the antennal seta *q* (striate, not annulate), the shape of the posteromedian setae of tergite VI (clavate and annulate, not thin and cylindrical) and the pubescence of the bothriotricha  $T_1$ ,  $T_2$  and  $T_4$  (very short, not long and whorled). The connections with *A. furcosus* are in the general shape of the  $T_3$ , similar setae on the tarsi of leg 9 and the general shape of the anal plate. Best distinguishing characters are the length of the antennal seta *r* (0.3 of the length of *p*, not 0.8), the shape of the end-swelling of the  $T_3$  (3.4 times as long as wide, not 1.6-1.8) and the form of the anal plate (trapeziform, not square). The similarities between *A. yoshii* sp. n. and *A. presbyteri* are less pronounced and the two species are easily distinguished by the proportion *plt* (1.4, not 2.0) and the shape of the  $T_3$  (with cylindrical axis and distinct end-swelling, not clavate).

Genus *Stylopauropus* Cook, 1896

Subgenus *Donzelotauropus* Remy, 1957

The genus *Stylopauropus* is mainly Holarctic, with only a few records from southern countries. There is a dubious record from Argentina and two species, probably introduced, have been reported from Australia (vide Scheller *et al.*, 1994). Moreover, two species in the nominate subgenus have been reported from Madagascar (Remy & Bello, 1960) and Sri Lanka (Remy, 1962) respectively.

In a sample from a *Lithocarpus-Castanopsis* forest on Mount Kinabalu the genus *Stylopauropus* (s.g. *Donzelotauropus*) appeared with a single juv. 6 specimen (Mount Kinabalu, "Bukit Ular Trail", path connecting "Kambarangan Road" and "Power Station", alt. 1850 m. 28.IV.1982, Loc. Sab-82/13). The genus and subgenus was previously reported from Borneo by Scheller *et al.* (1994), with a juv. 3 specimen collected in a secondary forest in southernmost Sabah (Mendolong, about 30 km SE Sipitang, forest logged ca 1960, sanitation felling in 1989, flotation of humus, 2.IX.1989, Loc. L41/2, leg. P. Brinck & P. H. Enckell). None of these two specimens could have been described, but they seem to belong to two different species.

Genus *Pauropus* Lubbock, 1867

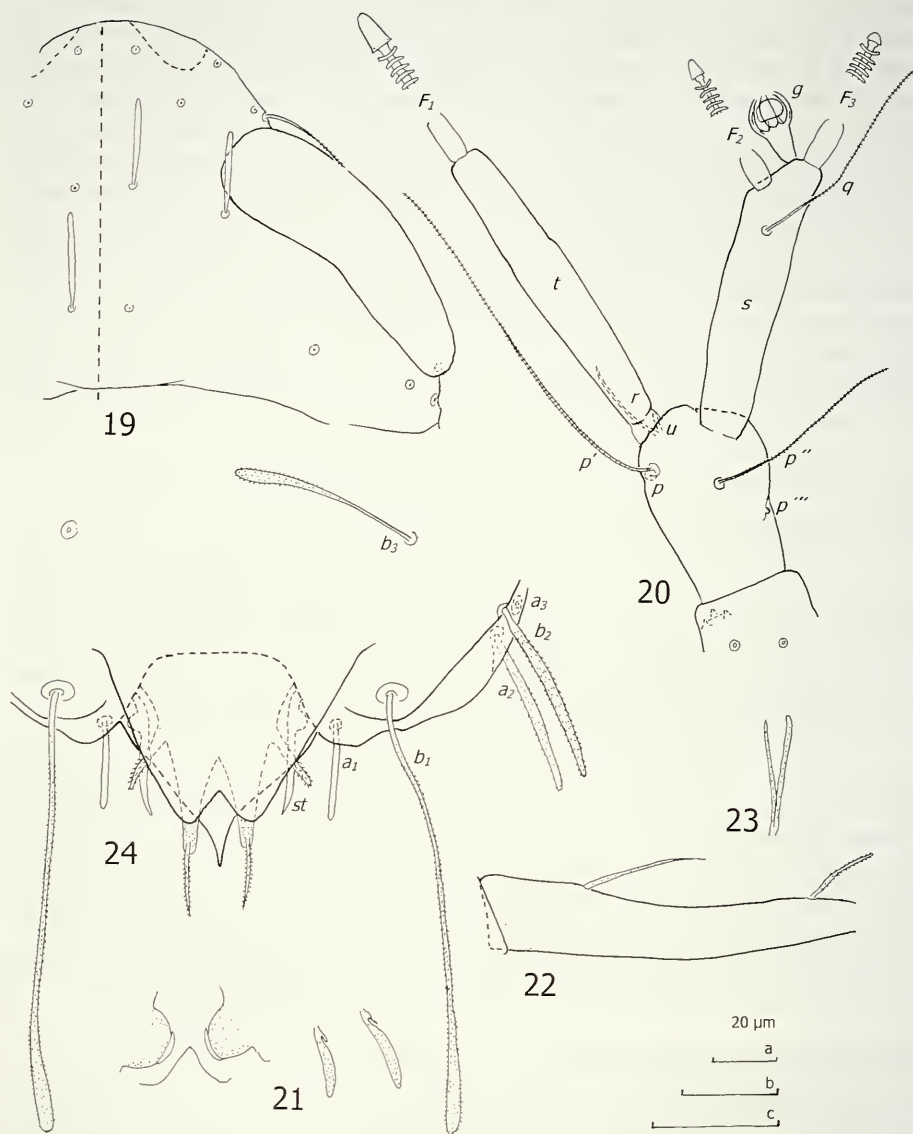
*Pauropus borneensis* sp. n.

Figs 19-24

*Type material. Holotype:* 1 ad. 9(♀), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", near "Pond", secondary lowland forest. litter, Berlese extraction, 10.V.1982 (Loc. Sab-82/41).

*Total number.* 1 specimen.

*Diagnosis.* *P. borneensis* may be closest to *P. wieheorum* Remy from Mauritius (Remy, 1959b). They have distinct similarities in the antennae and some of the pygidial setae and also in the shape of the anal plate. The following pygidial characters are good for distinguishing the species: setae  $a_1$  (glabrous in *P. borneensis* sp. n., with distinct pubescence in *P. wieheorum*); the lateral appendages of the anal plate



FIGS 19-24

*Pauropus borneensis* sp. n., holotype, ad. 9 (♀). 19, head, median and right part, tergal view; 20, left antenna, sternal view; 21, collum segment, median and left part, sternal view; 22, tarsus of leg 9; 23, seta on trochanter of leg 9; 24, pygidium, posterior part, sternal view. Scale a: Figs 21-23; b: Fig. 19; c: Figs 20, 24.

(straight, tapering, pubescent, not curved inwards, cylindrical, glabrous); the *st* (with proximal thickening on outer side, not on inner side); setae  $b_1$  (with distinct endswelling, not evenly thickening outwards); setae  $b_2$  (1.2 times as long as distance  $b_1 - b_2$ , not 1.9). There are connections also with *P. salvatgei* Remy from Madagascar (Remy, 1960) particularly in the shape of the sternal antennal branch (distinctly truncate in anterodistal end) and the pygidium (similar shape of the setae and the posterior lobe of the tergum) but the two species are dissimilar in many details. To a less degree the new species shows affinities also to *P. difficilis* Remy from Pondichéry (Remy, 1962).

*Etymology.* A latinized adjective of the name Borneo.

#### DESCRIPTION

*Length.* 0.85 mm.

*Head.* Most tergal setae lacking, those studied rather long, somewhat lanceolate, blunt, glabrous.  $a_3$  of 2<sup>nd</sup> row inserted laterally, thin, striate, tapering, and pointed. Lengths of setae, 1<sup>st</sup> row:  $a_1 = ?$ ,  $a_2 = ?$ ; 2<sup>nd</sup> row:  $a_1 = ?$ ,  $a_2 = ?$ ,  $a_3 = 22$ , 3<sup>rd</sup> row:  $a_1 = 19$ ,  $a_2 = 18$ ; 4<sup>th</sup> row:  $a_1 = 12$ ,  $a_2 = ?$ ,  $a_3 = ?$ ,  $a_4 = ?$   $\mu\text{m}$ ; lateral group of setae not studied. The ratio  $a_1/a_1 - a_1$  in 3<sup>rd</sup> row 1.6 and in 4<sup>th</sup> row 1.7. Anterior part of temporal organs in tergal view only somewhat broader than posterior part, 1.3 times as long as their shortest distance apart and each with an aperture in posterior part. Head cuticle glabrous.

*Antennae.* Segment 4 with 5 thin setae, *u* cylindrical, the others tapering, pointed, striate. Their lengths:  $p = ?$ ,  $p' = 61$ ,  $p'' = 33$ ,  $p'''$  rudimentary knob,  $r = 16$ ,  $u = 1.5$   $\mu\text{m}$ . Tergal branch *t* slender, fusiform, 6.2 times as long as its greatest diameter and 1.1 times as long as sternal branch *s*. The latter slender and 4.5 times as long as its greatest diameter; anterodistal corner of *s* strongly truncate. Seta *q* as seta  $p'$  of 4th segment, 0.8 of the length of *s*. Relative lengths of flagella (base segments included) and base segments:  $F_1 = 100$ ,  $bs_1 = 6$ ;  $F_2 = 67$ ,  $bs_2 = 5$ ;  $F_3 = 81$ ,  $bs_3 = 6$ . The  $F_1$  2.8 times as long as *t*,  $F_2$  and  $F_3$  2.1 and 2.6 times as long as *s*, respectively. Distal calyces of  $F_1$  almost subcylindrical, those of  $F_2$  more conical, those of  $F_3$  subhemispherical; distal part of flagella axes cylindrical, not widened. Globulus *g* 1.5 times as long as wide, with 8 bracts, capsule bottom flattened; width of *g* 0.9 of the greatest diameter of *t*. Antennae glabrous.

*Trunk.* Setae of collum segment furcate, primary branch thick, fusiform, blunt, with very short pubescence; secondary branch rudimentary, pointed; sublateral setae 1.1 times as long as submedian ones; sternite process subtriangular, not divided anteriorly; appendages short, wide, with low caps, process glabrous. appendages with short minute pubescence.

Setae on tergites fusiform, with short pubescence. 4+4 setae on tergite I, 6+6 on II-V, 4+? on VI. Tergites almost glabrous.

*Bothriotricha.* Axes thin and pubescence short.

*Legs.* Setae on coxa and trochanter of leg 9 similar, furcate, branches cylindrical, tapering distally, with very short pubescence. Tarsus of leg 9 slender, tapering, somewhat curved, 5.1 times as long as its greatest diameter. Setae with short

oblique pubescence, proximal one tapering, pointed, its length 0.3 of the length of tarsus and 1.7 times as long as subcylindrical, tapering distal seta. Cuticle of proximal third of tarsus with minute pubescence.

*Pygidium. Tergum.* Posterior margin between  $a_1$  with large posteriorly directed lobe with rounded lateral margins and a distinct posteromedian point. Relative lengths of setae:  $a_1 = 10$ ,  $a_2 = 18$ ,  $a_3 = 21$ ,  $st = 14$ .  $a_1$  and  $st$  glabrous and directed posteriorly, the former cylindrical, blunt, the latter pointed, weakly S-shaped and with a distinct lateral swelling in proximal third;  $a_2$  and  $a_3$  blunt, fusiform, very weakly curved inwards, diverging and with short oblique pubescence. Distance  $a_1 - a_1$  2.5 times as long as  $a_1$ ; distance  $a_1 - a_2$  5.8 times as long as distance  $a_2 - a_3$ , distance  $st - st$  1.2 times as long as  $st$  and 0.7 of distance  $a_1 - a_1$ . Cuticle glabrous.

*Sternum.* Posterior margin between  $b_1$  with large posteriorly directed lobe below anal plate, lobe 1.5 times as broad as long and most posteriorly with distinct V-shaped incision. Relative lengths of setae ( $a_1 = 10$ ):  $b_1 = 50$ ,  $b_3 = 21$ . These setae thin but with distal clavate swelling; pubescence very short on  $b_1$ , especially on the swelling, short but distinct on  $b_3$ . The  $b_1$  2.4 times as long as their distance apart,  $b_3$  0.5 of the length of distance  $b_3 - b_3$ .

Anal plate broadest anteriorly, 1.3 times as long as its greatest width and with concave lateral margins and a deep V-shaped posterior incision. Plate with 4 subcylindrical appendages: two lateral ones directed obliquely backwards, their pubescence distinct; two posteriorly directed ones protruding from the posterosternal side of the posterior lobes of the plate, thin, tapering, pointed and with short erect pubescence. Length of lateral and posterior appendages 0.3 and 0.4 of the length of the plate, respectively. Distal part of plate with minute pubescence.

Genus *Hemipauropus* Silvestri, 1902

*Hemipauropus melanesicus* Scheller

*Hemipauropus melanesicus* Scheller, 1993: p. 56-58, figs 131-140.

*Material examined.* SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, Berlese extraction, 1 subad. 8(♂), 10.V.1982 (Loc. Sab-82/42).

*Total number.* 1 specimen.

*General distribution.* This is the second record of *H. melanesicus*, the species was previously known from New Caledonia only (Scheller, 1993).

BRACHYPAUROPODIDAE

Genus *Brachypauropoides* Remy, 1952

Eight species have been described in *Brachypauropoides* but the full range of the genus is still unknown and its generic limits are unclear (the taxon is defined by the number of digitiform appendages of the temporal organs and the number of tergal setae). *Brachypauropoides* has been collected on Madagascar, Borneo and New Zealand but it will certainly appear in many Asian and Australian places in future

collections. Eight previously known species can be listed:

SPECIES	DISTRIBUTION	REFERENCES
<i>B. actaeus</i> Remy & Rollet	Madagascar	Remy & Rollet, 1960
<i>B. baculifer</i> Remy & Rollet	Madagascar	Remy & Rollet, 1960
<i>B. massoti</i> Remy	Madagascar	Remy, 1956c Remy & Bittard, 1957 Remy & Bello, 1960 Remy & Rollet, 1960
<i>B. norberti</i> Remy & Bello	Madagascar	Remy & Bello, 1960
<i>B. penanorum</i> Scheller	Sabah (Mendolong)	Scheller <i>et al.</i> , 1994
<i>B. permolestus</i> Remy & Rollet	Madagascar	Remy & Rollet, 1960 Remy & Bello, 1960
<i>B. pistillifer</i> Remy	New Zealand	Remy, 1952 Remy, 1956c Remy & Rollet, 1960
<i>B. praestans</i> Remy	New Zealand	Remy, 1956c

A ninth species is described in the following:

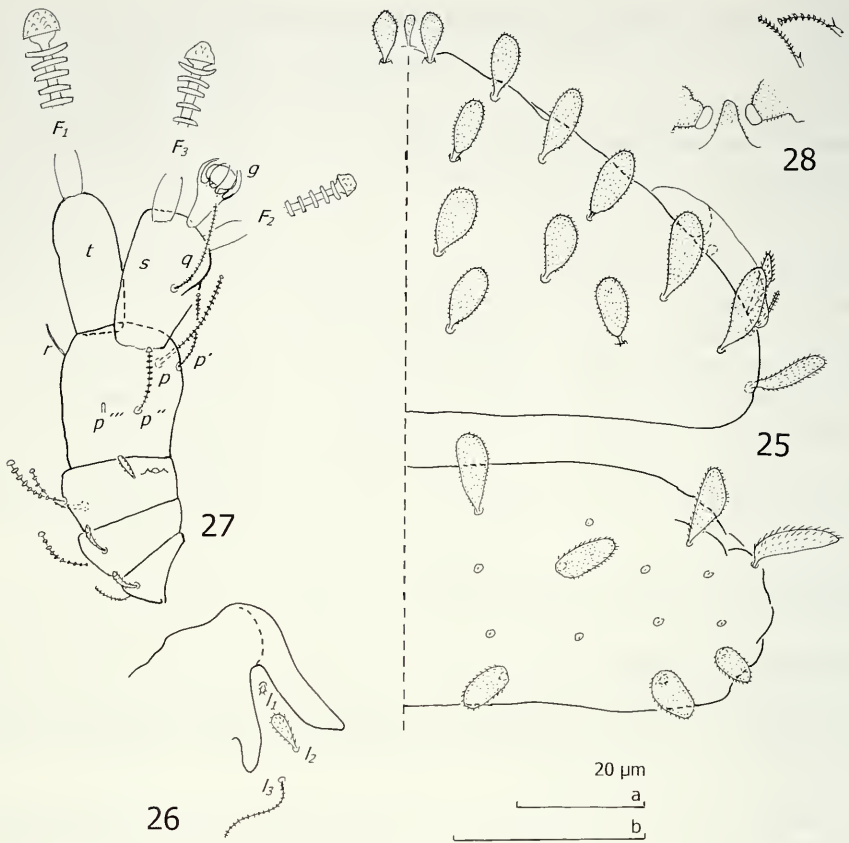
***Brachypauropoides prolatus* sp. n.**

Figs 25-38

*Type material. Holotype:* ad. 9 (♂), SABAH, Interior Residency, road to Kimanis, 16 km from Keningau, alt. 1170 m, soil sample from between buttresses of a dead tree, Berlese extraction, 13.V.1982 (Loc. Sab-82/50).

*Total number.* 1 specimen.

*Diagnosis.* Because the species of *Brachypauropoides* are so incompletely known the relationships of the new species is impossible to trace. It may, however, be most close to *B. praestans* Remy from New Zealand (Remy, 1956a) and to *B. massoti* Remy and *B. norberti* Remy & Bello, the latter two from Madagascar (Remy, 1956c; Remy & Bello, 1960). The similarities among these species are mainly of general character (the shape of the anal plate and the setae of the head and the tergites). The new species can be distinguished from them by the shape of the temporal organs (3 uplifted appendages in *B. prolatus* sp. n., one only in *B. praestans*, *B. massoti* and *B. norberti*). Other distinctive characters of *B. praestans* are the shape of the tergal antennal branch *t* (2.1 times instead of 3 times as long as its greatest width), the proportion  $t/F_1$  (0.6, not 0.3), the shape of the pygidial setae  $a_2$ ,  $a_3$  and *st* (the two former tapering, broadest in the middle, the latter fungiform in *B. prolatus* sp. n., the two former clavate, broadest in distal half and claviform, respectively, in *B. praestans*). Apart from the shape of the temporal organs, good distinctive characters can also be found in relation to *B. massoti* and *B. norberti*. In *B. massoti* the setae of the tergites are different (thick, bladder-shaped in *B. prolatus* sp. n., thinner and clavate in *B. massoti*) and so are the appendages of the anal plate (cylindrical, not clavate). The setae on the central part of the tergal side of the head are uniform in *B. prolatus* sp. n. but in *B. norberti* two setae are very small and two others are distinctly



FIGS 25-28

*Brachypauropoides prolatus* sp. n., holotype, ad. 9(♂). 25. head and tergite 1, right half, tergal view; 26, temporal organ with lateral group setae, posterior part, left side; 27, right antenna, sternal view; 28, collum segment, median and left part, sternal view. Scale a: Fig. 28; b: Figs 25, 26, 27.

longer; the tergites are almost glabrous, not distinctly granular and the *st* are fungiform, not cylindrical.

*Etymology.* From Latin *prolatus* = extended (anal plate).

#### DESCRIPTION

*Length.* 0.51 mm.

*Head.* Tergal and lateral sides with 31 setae arranged as in Figs 25 and 26; transversal rows difficult to interpret. Relative lengths of the 5 submedian setae: 10, 14, 14, 14, 14; lateral group:  $l_1$  short, bladder-shaped, relative length (first submedian seta = 10) = 2,  $l_2$  subclavate = 14,  $l_3$  thin, striate, pointed = 22. All setae but  $l_3$  bladder-shaped with distinct oblique-erect pubescence. Temporal organs complicated (posterior part in Fig. 26) with three uplifted tube-like appendages, two posterior and one

anterior. Longest appendage about  $\approx 0.5$  of the length of organ and protruding downwards from the posterior end; the two other appendages short, one near the mouth and the other anterior of the longest appendage. Tergal side of head and temporal organs glabrous.

*Antennae.* Segment 3 with 3 setae, one short clavate, distinctly pubescent and inserted near a rudimentary globulus, the other two somewhat clavate annulate setae. Segment 4 with 5 setae,  $p'''$  and  $r$  cylindrical and glabrous, the others subcylindrical and annulate; relative lengths of them:  $p = 100$ ,  $p' = 72$ ,  $p'' = 64$ ,  $p''' = 9$ ,  $r = 36$ . Tergal seta  $p$  0.7 of the length of tergal branch  $t$ . The latter subcylindrical, distal part tapering, 2.1 times as long as its greatest width, as long as sternal branch  $s$ . The latter thickest in distal 1/3, with anterodistal corner truncate, 1.7 times as long as its greatest diameter; its seta  $q$  subcylindrical, tapering, pointed, annulate, 0.7 of the length of  $s$ . Relative lengths of flagella (base segments included) and of base segments alone:  $F_1 = 100$ ,  $bs_1 = 8$ ;  $F_2 = 74$ ,  $bs_2 = 6$ ,  $F_3 = 83$ ,  $bs_3 = 7$ . The  $F_1$  3.6 times as long as  $t$ ,  $F_2$  and  $F_3$  2.7 and 3.0 times as long as  $s$  respectively. The  $F_2$  thinner than  $F_1$  and  $F_3$ . Distal calyces subhemispherical, with short pubescence. Globulus  $g$  with slender stalk, 1.7 times as long as its greatest diameter being 0.6 of the greatest diameter of  $t$ . Antennal stalk and branches glabrous, calyces with sparse pubescence.

*Trunk.* Setae of collum segment furcate, primary branch cylindrical, blunt, annulate; secondary branch rudimentary glabrous; sublateral seta 1.1 times as long as submedian one. Sternite process blunt, appendages conical with glabrous caps; process and appendages with short pubescence.

Tergites I, III, V, VI entire, II and IV weakly divided transversely. Number of setae on tergites (if two values they are the anterior and posterior groups respectively): I 30, II 15+18 = 33, III 36+19 = 55, IV 24+19 = 43, V 27, VI 4+2 = 6. Setae bladder-shaped, with distinct oblique-erect pubescence, stalk inserted unsymmetrically. Cuticle of tergites pubescent.

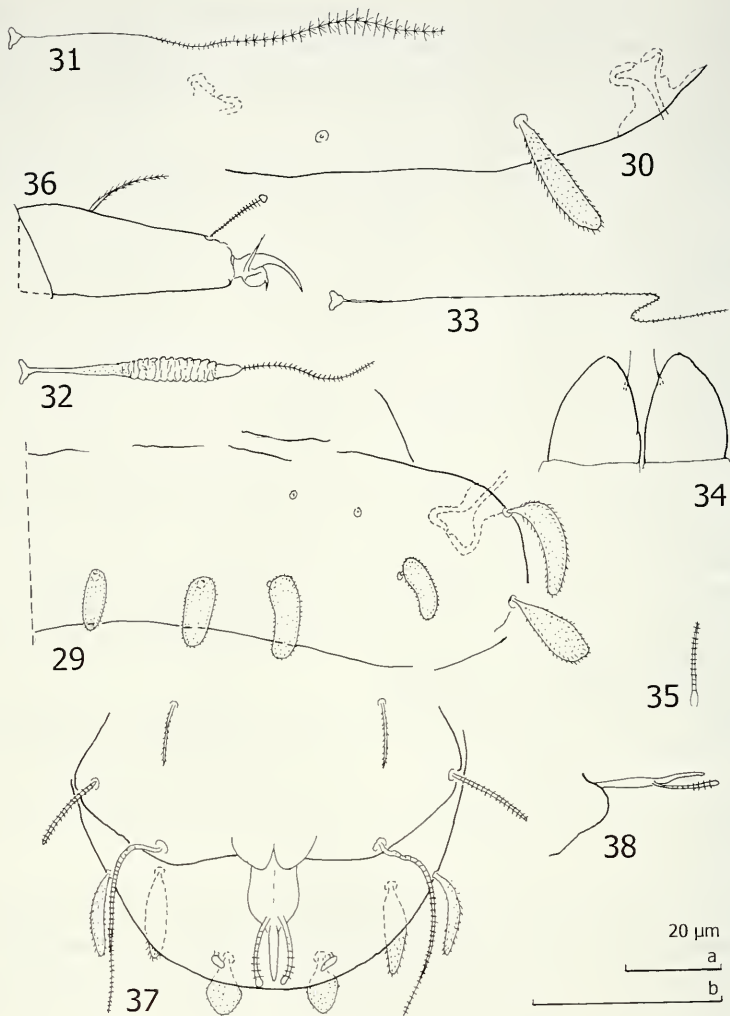
*Bothriotricha.* Relative lengths of bothriotricha:  $T_1 = 100$ ,  $T_2 = 112$ ,  $T_3 = 82$ ,  $T_4 = 85$ ,  $T_5 = 104$ . They have simple axes, being glabrous most proximally. Pubescence on  $T_1$ ,  $T_2$  and  $T_4$  distinct and consisting of erect hairs arranged in whorls;  $T_5$  curled distally, its pubescence very short, almost erect. Proximal half of  $T_3$  strongly clavate, almost glabrous, surface with many ring-shaped folds; distal half very thin with short pubescence arranged in whorls.

*Genital papillae*<sup>3</sup>. Short, 1.3 times as long as their greatest diameter, widest in proximal half, glabrous, seta almost 0.6 of the length of papilla.

*Legs.* All legs 5-segmented. Setae on coxa and trochanter of leg 9 similar, simple, cylindrical, annulate, blunt, without traces of secondary branches. These setae are more anteriorly somewhat thinner and with short cylindrical glabrous rudiments of secondary branches on legs 2, 3 and 4.

Tarsus of leg 9 short, tapering, 2.2 times as long as its greatest diameter.

<sup>3</sup> The "penes" in Pauropoda are not transferring sperm from the male genital orifice directly into the female genital orifice. Thus, they are not copulatory organs in the proper sense of the word and consequently "penis, penes" are here replaced by "genital papilla, genital papillae".



FIGS 29-38

*Brachypauropoides prolatus* sp. n., holotype, ad. 9(♂). 29, tergite II, anterior part, right side; 30, tergite VI, posteromedian and right posterior part; 31,  $T_1$ ; 32,  $T_3$ ; 33,  $T_5$ ; 34, genital papillae, anterior view; 35, seta on coxa of leg 9; 36, tarsus of leg 9; 37, pygidium, sternal view; 38, anal plate, lateral view. Scale a: Figs 31-33; b: Figs 29, 30, 34-38.

Proximal seta 0.4 of the length of tarsus, with oblique pubescence; distal seta somewhat clavate, annulate, blunt, 0.3 of the length of tarsus and 0.8 of the length of proximal seta. Cuticle of tarsus almost glabrous.

*Pygidium. Tergum.* Hind margin evenly rounded. Relative lengths of setae:  $a_1 = 10$ ,  $a_2 = 16$ ,  $a_3 = 15$ ,  $st = 3$ . The  $a_1$  and  $a_2$  similar to setae on tergites,  $a_1$  posteriorly directed, broadly clavate, with very short erect pubescence.  $a_2$  and  $a_3$  lanceolate, with



distinct oblique pubescence,  $a_2$  straight and directed posteriorly,  $a_3$  diverging and curved inwards;  $st$  short, fungiform, glabrous, ovoid, with sparse but distinct oblique pubescence, these setae very similar to those on the tergites. Distance  $a_1 - a_1$  1.7 times as long as  $a_1$ , distance  $a_1 - a_2$  considerably longer than distance  $a_2 - a_3$ ; distance  $st - st$  6 times longer than  $st$  and 1.2 times as long as distance  $a_1 - a_1$ . Tergum glabrous.

**Sternum.** Sternum hexagonal, posterior margin between  $b_1$  with shallow indentation and a semicircular lobe below anal plate; lobe with distinct posterodistal incision. Relative lengths of setae (pygidial  $a_1 = 10$ ):  $b_1 = 45$ ,  $b_2 = 16$ ,  $b_3 = 12$ . The  $b_1$  thin, subcylindrical, tapering, striate, pointed,  $b_2$  and  $b_3$  cylindrical, striate, the latter thinner than the former. The  $b_1$  1.1 times as long as distance  $b_1 - b_1$ ,  $b_2$  about as long as distance  $b_1 - b_2$  and  $b_3$  0.3 of distance  $b_3 - b_3$ .

Anal plate 1.8 times as long as its greatest width, somewhat widening from its base, lateral margins almost straight, broadest just behind the middle; distal part narrow with parallel lateral margins and blunt end; two thin cylindrical, sparsely striate appendages protruding backwards from the middle of the sternal side, appendages curved inwards, their length 0.6 of the plate length.

#### EURYPAUROPODIDAE

Six species in the family are now known from Sabah. One species was reported previously, *Samarangopus segniter* Scheller (Scheller *et al.*, 1994), but Dr Hauser's collection indicates a much more diversified eurypauropodid fauna. Three more species in *Samarangopus* and two species in *Sphaeropauropus* appeared in his collection, all new to science.

#### Genus *Samarangopus* Verhoeff, 1934

#### *Samarangopus longipenes* sp. n.

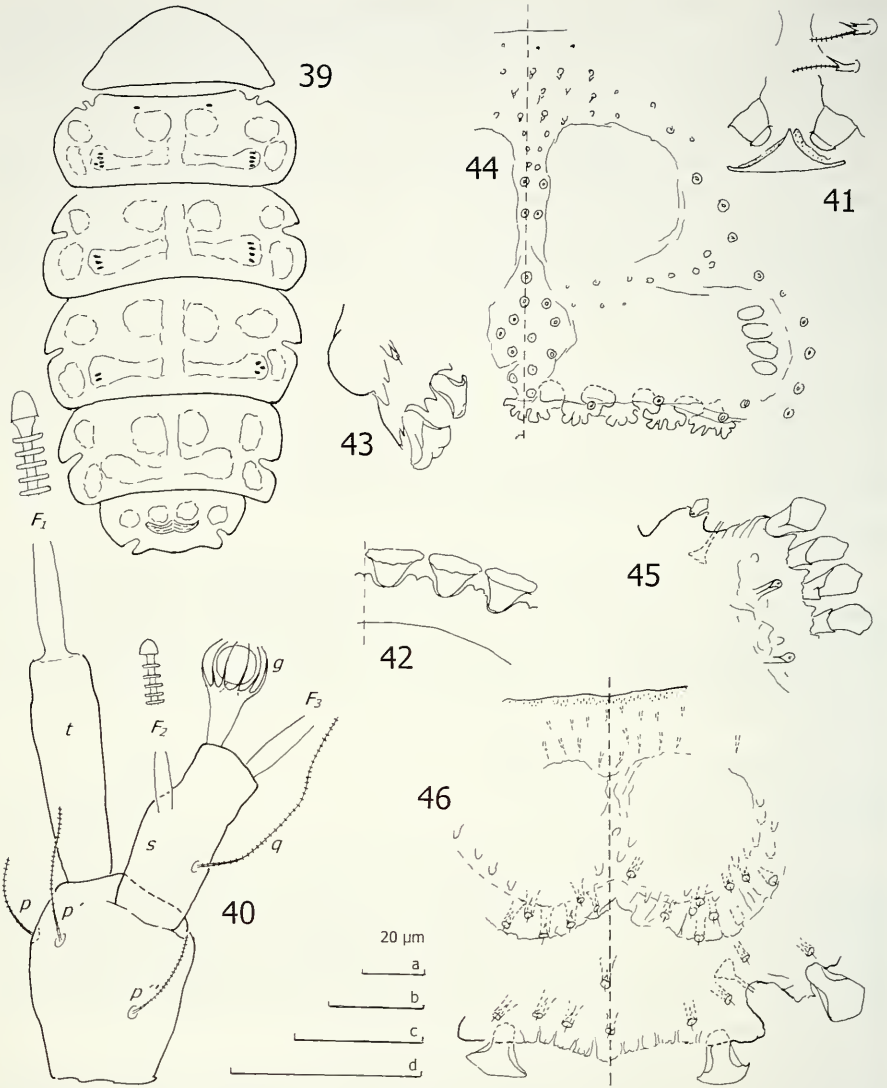
Figs 39-53

**Type material.** **Holotype:** ad. 9(♂), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", lowland Dipterocarp forest near "Orang-Utan Rehabilitation Station", sifting of litter from between buttresses of large trees, Winkler-Moczarski extraction, 3.V.1982 (Loc. Sab-82/27). **Paratypes:** 1 ad. 9(♂), SABAH, Interior Residency, road to Kimanis, 26 km from Keningau, helicopter port, sifting in cloud forest, alt. 1380 m, Berlese extraction, 12.V.1982 (Loc. Sab-82/43b). 1 ad. (♀); SABAH, Sandakan Residency, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, Berlese extraction, 10.V.1982 (Loc. Sab-82/42).

**Total number.** 3 specimens.

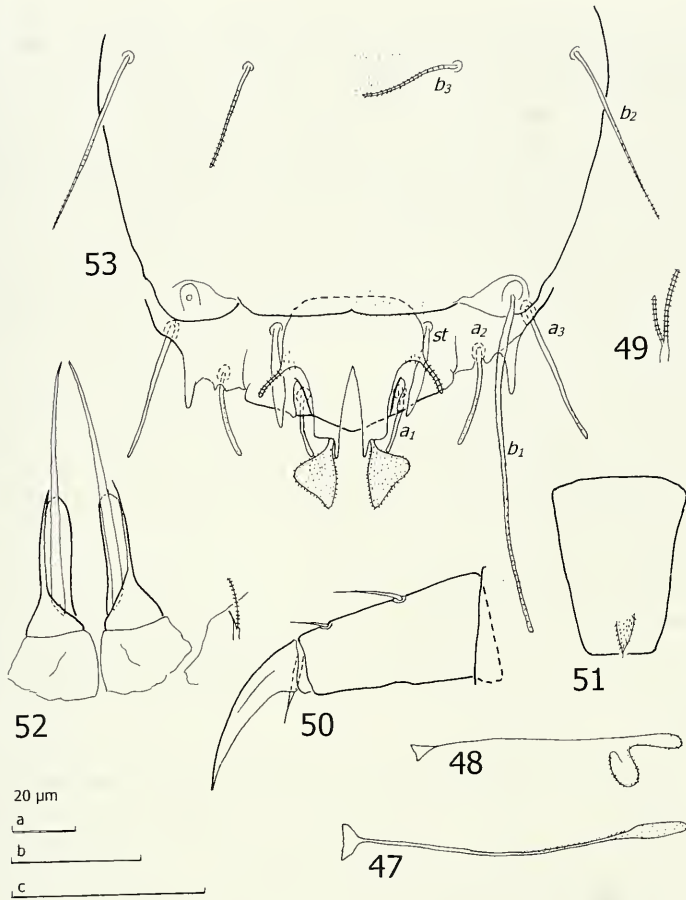
**Diagnosis.** *S. longipenes* sp. n. may be grouped together with *S. palearum* Scheller from New Caledonia (Scheller, 1993) and *S. flabrarius* Remy from Madagascar (Remy, 1956c). The former species and *S. longipenes* sp. n. have similarities in the structure of the tergites (several surface details) and comparing it with *S. flabrarius*, e.g., the anal plate and the number of lateral protuberances of the tergites are similar. The shape of the genital papillae in *S. flabrarius*, with their long and thick setae, is another character which indicates relationships to that species.

Distinctive characters in relation to *S. palearum* are: the shape of the calyces of the antennal flagella  $F_1$  (longish in *S. longipenes* sp. n., short in *S. palearum*); the length of the seta  $q$  (about as long as or longer than  $s$ , not much shorter than  $s$ ); the shape of the genital papillae (with tube-like lengthening and very long and thick seta).



FIGS 39-46

*Samarangopus longipenes* sp. n., holotype, ad. 9(♂). 39, body with tergites I-VI showing the shape of the depressions (marginal setae not shown); 40, left antenna, sternal view; 41, collum segment, median and left part, sternal view; 42, tergite I, part of anterior margin, sternal view; 43, tergite I, left posterior corner, sternal view; 44, tergite I, median and submedian part, right side; 45, tergite II, right anterolateral corner, tergal view; 46, tergite VI, median part. Scale a: Figs 43-45; b: Figs 41, 46; c: Fig. 42; d: Fig. 40.



FIGS 47-53

*Samarangopus longipenes* sp. n., holotype, ad. 9(♂). 47,  $T_3$ ; 48,  $T_4$ ; 49, seta on trochanter of leg 9; 50, tarsus of leg 9; 51, femur of leg 1 with appendage; 52, genital papillae and seta on coxa of leg 2, anterior view; 53, pygidium, sternal view. Pubescence only partly drawn in 53. Scale a: Fig. 52; b: Figs 47-51; c: Fig. 53.

not of normal shape and with short seta); the shape of the central part of tergite VI (two raised rounded bulges vs. no bulges at all).

Diagnostic characters which allow to distinguish *S. longipenes* sp. n. from *S. flabrarius* are: the shape of the stalk of the antennal globulus (long and slender in *S. longipenes* sp. n., not short and thick); the shape of the distal part of the  $T_3$  (clavate end-swelling, not a swelling with incision), the shape of the genital papillae (with tube-like lengthening in *S. longipenes* sp. n., no lengthening in *S. flabrarius*).

*Etymology.* From Latin longus = long and penis = male genital papilla.

## DESCRIPTION

*Length.* 0.84(-0.92) mm.

*Head.* Setae hidden.

*Antennae.* Antennae glabrous; chaetotaxy of segments 1-4: 2/2/2/3;  $g'$  not identified; setae thin, cylindrical, striate-annulate, their lengths on segment 4:  $p = 10$ ,  $p' = 15$ ,  $p'' = 14$ ; no  $p'''$ ,  $u$  and  $r$ . Sternal branch  $s$  subcylindrical but with distinct anterior truncation, anterior margin = (10-) 11, posterior margin = 18(-20),  $\emptyset$  of base = (6-)7, maximum  $\emptyset = 8(-10)$ ,  $q$  thin, tapering, cylindrical, annulate-striate,  $l = (20-)$ 23  $\mu\text{m}$ . Posterior margin/length of  $g$  1.6(-1.8), posterior margin/maximum  $\emptyset = (2.0-)$ 2.2, maximum  $\emptyset/\emptyset$  of base = 1.1(-1.6). Tergal branch subcylindrical, widest in distal half,  $l = (23-)$ 24,  $\emptyset$  of base = 5, maximum  $\emptyset = 7$   $\mu\text{m}$ , pore not ascertained; length of  $t$ /maximum  $\emptyset = 3.3(-3.4)$ . Globulus  $g$ ,  $l = 11$ , maximum  $\emptyset = (6-)$ 7  $\mu\text{m}$ , length/maximum  $\emptyset = 1.6(-1.8)$ , number of bracts (8-)9, their length = 7, capsule spherical,  $\emptyset = 4$   $\mu\text{m}$ . Relative lengths of flagella (base segments included):  $F_1 = 100$ ,  $F_2 = (41-)$ 46,  $F_3 = 79(-89)$ . Lengths of base segments.  $bs_1 = 12$ ,  $bs_2 = 6(-7)$ ,  $bs_3 = (9-)$ 10(-11)  $\mu\text{m}$ . The  $F_1$  3.2(-3.4) times as long as  $t$ ,  $F_2$  and  $F_3$  (1.6-)1.8 and 3.1(-3.3) times as long as  $s$  respectively. The  $F_2$  thinner than  $F_1$  and  $F_3$ . Calyces conical, those of  $F_1$  longish, those of  $F_2$  and  $F_3$  subhemispherical.

*Trunk.* Setae of collum segment similar to each other; furcate; main branch subcylindrical, tapering, striate, pointed; secondary branch rudimentary, pointed, glabrous; both setae  $l = 13$   $\mu\text{m}$ . Sternite process broadly triangular, appendages barrel-shaped, caps with collar; process with short pubescence on margins, appendages and caps glabrous.

*Tergites.* Tergites with broadly campanulate protuberances arranged in a single row on the anterior and lateral margins of tergite I, lateral margins of II-V and posterior margin of VI. 3 types of subcuticular structures present: simple conical structures under the epicuticula on the anterior parts of tergites II-VI and subcylindrical structures opening in the epicuticula, some with a very narrow opening and others with a funnel-shaped opening, on the lateral and posterior parts of all tergites.

Tergites I-VI with a symmetric but complicated pattern of depressions with bare bottom surrounded by raised cuticle with the above mentioned subcylindrical structures (figs 39, 44, 46). On VI two such depressions posteriorly separated by a broadly V-shaped incision. Number of campanulate marginal protuberances: I 23; II, 1 small —  $T_1$  — (8-) 9; III, 1 small + 3 —  $T_2$  — 6; IV, 1 small 1 + 4 —  $T_3$  — 4(- 5); V, 1 small + (4-) 5 —  $T_4$  — 3(-4); VI, 1 small + (4-)5 —  $T_5$  — 1. Length/width ratio of tergites: I = 0.5, II = III = IV = 0.4, V = VI = 0.4(-0.5).

*Bothriotricha.* All bothriotricha but  $T_3$  curled distally and with very thin axes; these glabrous except for a minute pubescence in their distal third. The  $T_3$  with thicker axes and the distal fourth increasing in width, forming a distal clavate end-swelling with minute pubescence; length of end-swelling about 1/5 of the length of bothriotrix. Relative lengths of bothriotricha (holotype only):  $T_1 = 100$ ,  $T_2 = 99$ ,  $T_3 = 55$ ,  $T_4 = 83$ ,  $T_5 = 77$ .

*Genital papillae.* Base segments in the shape of truncated cones, relatively long.

Length of papillae = (40-)45-50, greatest  $\emptyset$  = 18, length of seta = (80-)81  $\mu\text{m}$ . Proximal part of papillae strongly tapering outwards, distal 2/3 forming an anteriorly open tube enclosing the long and thick setae with 1.3(-1.7) times the length of the papillae. Papillae (2.4-2.7) times as long as greatest diameter. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, length = 20  $\mu\text{m}$ .

*Legs.* All legs 5-segmented. Seta on coxa and trochanter of leg 9 subsimilar, furcate, striate, bases glabrous; length of secondary branch 0.5 of primary one. More anteriorly these setae thinner and with rudimentary pointed glabrous secondary branches. Tarsi short, tapering, those of leg 9 1.6(-1.8) times as long as its greatest diameter; two tergal setae, both pointed glabrous; length of proximal one 11(-14)  $\mu\text{m}$ , distal one 6(-8)  $\mu\text{m}$ . Proximal setae 0.3(-0.4) of the length of tarsus and (1.7-)1.8 times as long as distal seta. Cuticle of tarsus almost glabrous. No proximal seta on tarsus of leg 1. All legs with large main claw and small setose anterior secondary claw; in leg 9 the former reaching 0.9 of the length of tarsus. On anterior side of femur of leg 1 a pointed appendage with short pubescence, length = (6-)7  $\mu\text{m}$ .

*Pygidium. Tergum.* Posterior margin between the  $b_1$  divided into 3 lobes. a posteriorly triangular median one and on each side of it a less pronounced lobe. Outside these lobes and between  $a_2$  and  $a_3$  a posteriorly directed digitiform appendage with almost the length of  $a_1$ . The  $a_1$  and  $a_2$  cylindrical, blunt, glabrous, somewhat curved inwards and converging;  $a_3$  subcylindrical, tapering, glabrous, diverging; *st* knife-like somewhat converging. Lengths of setae:  $a_1 = (7-)$ 8,  $a_2 = 9(-10)$ ,  $a_3 = (11-)$ 15, *st* = 10(-13)  $\mu\text{m}$ . Distance  $a_1 - a_1 = 10(-11)$ ,  $a_2 - a_2 = 27(-30)$ ,  $a_3 - a_3 = (30)32$ ,  $a_1 - a_2 = (7-)$ 8,  $a_2 - a_3 = (5-)$ 7, *st - st* = (16-)17  $\mu\text{m}$ . Distance  $a_1 - a_1$  1.2(-1.5) times as long as  $a_1$ , distance  $a_1 - a_2$  1.2(-1.4) times as long as distance  $a_2 - a_3$ ; distance *st - st* (1.2-) 1.7 times as long as *st* and 1 -1.3 times as long as distance  $a_1 - a_1$ . Cuticle glabrous.

*Sternum.* Posterior margin almost straight but with 3 shallow indentations, two submedian and a smaller median one. Setae thin.  $b_3$  striate,  $b_1$  and  $b_2$  glabrous but with indistinct striation most distally. Lengths of setae:  $b_1 = (35-)$ 37(-43),  $b_2 = 20(-23)$ ,  $b_3 = (11-)$ 12  $\mu\text{m}$ . Distance  $b_1 - b_1 = 34(-36)$ ,  $b_2 - b_2 = 47(-49)$ ,  $b_3 - b_3 = 22(-23)$ ,  $b_1 - b_2 = (25-)$ 26,  $b_2 - b_3 = 12(-13)$   $\mu\text{m}$ . Distance  $b_1 - b_1$  (0.8-)0.9(- as long as) the length of  $b_1$ ,  $b_2$  0.8(-0.9) of distance  $b_1 - b_2$ ,  $b_3$  0.5 of the distance  $b_3 - b_3$ .

Anal plate 1.1 times as long as broad, widest anteriorly, broadest part about twice as wide as distal part; broadest part forming posterolateral corners, from there two short, thin, cylindrical, blunt, striate appendages protruding obliquely backwards; appendages 0.2 of the length of plate; posterior 2/5 of plate divided into two tapering branches by a narrow V-shaped incision, each branch cut squarely and provided with two appendages: a submedian short straight glabrous one and a stalked bladder of triangular shape in sternal view. Bladder-shaped appendages 0.4 of the length of plate. Plate glabrous, bladder-shaped appendages with short erect pubescence.

*Samarangopus ternarius* sp. n.

Figs 54-70

*Type material. Holotype:* ad. 9( $\sigma$ ), SABAH, Sandakan Residency, 24 km W of Sandakan. Sepilok, "Kabili-Sepilok Forest Reserve", lowland dipterocarp forest near "Orang-Utan Rehabilitation Station", sifting of litter from between buttresses of large trees, Winkler-

Moczarski extraction, 3.V.1982, (Loc. Sab-82/27). **Paratypes:** 1 subad. 8(♂), same locality and date as for the holotype. 2 ad. 9(♀), "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, Berlese extraction, 10.V.1982 (Loc. Sab-82/41).

*Other material.* SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili Sepilok Forest Reserve", lowland dipterocarp forest near "Orang-Utan Rehabilitation Station", sample from rotten log, Berlese extraction, 1 juv. 6, 1 juv. 5, 24.-26.IV. 1982 (Loc. Sab-82/5-I). Ibidem, 1 subad. 8(♂), 26.IV.-2.V. 1982 (Loc. Sab-82/5-II). Ibidem, secondary lowland forest close to "Pond", litter and rotten log sample, Berlese extraction, 1 ad. 9(♀), 10.V.1982 (Loc. Sab-82/42).

*Total number.* 8 specimens.

*Diagnosis.* *S. ternarius* sp. n. is well defined by the unique shape of the genital papillae and the styli, and it might be closely related to *S. jacobsoni* (Silvestri) from Java (Silvestri, 1930; Scheller, 1998). They are similar as to the shape of the subcuticular organs of the tergites and the shape of the protuberances of the anterior margin of tergite I. The antennae are similar too, as are the large winged pygidial setae  $b_2$ . They are easily distinguished by the number of marginal protuberances on tergite I (27 in *S. ternarius* sp. n., 22 in *S. jacobsoni*), by the shape of the calyces of the antennal flagella  $F_1$  (conical, not subhemispherical), as well as by the shape of the styli and the anal plate (stalked lanceolate styli and in sternal view triangular bladder-shaped appendages of the anal plate in *S. ternarius* sp. n., in *S. jacobsoni* both the styli and the bladder-shaped appendages of the anal plate are clavate).

A few characters indicate relationships to *S. palearum* Scheller from New Caledonia (Scheller, 1993) and *S. flabrarius* Remy and *S. saproxylophilus* Remy from Madagascar (Remy, 1956c). *S. palearum* is similar in both the cuticular structures and the transversal ridges of the tergites but is easily distinguished from *S. ternarius* sp. n. by the shape of the large protuberances of the tergites, the pygidial setae  $a_2$ ,  $a_3$ ,  $st$  and  $b_2$ , as well as by the distal appendages of the anal plate. The two Madagascan species have similarities with *S. ternarius* sp. n. in the distribution of the large protuberances of the tergites and in the shape of the distal appendages of the anal plate, *S. flabrarius* additionally by its large setae on the genital papillae. They are, however, easy to distinguish from *S. ternarius* sp. n. by the shape of the antennal globulus, the  $T_3$  and the genital papillae (*S. flabrarius*), and by the shape of the posterolateral appendages of the pygidial tergum and the distal part of the anal plate (*S. saproxylophilus*).

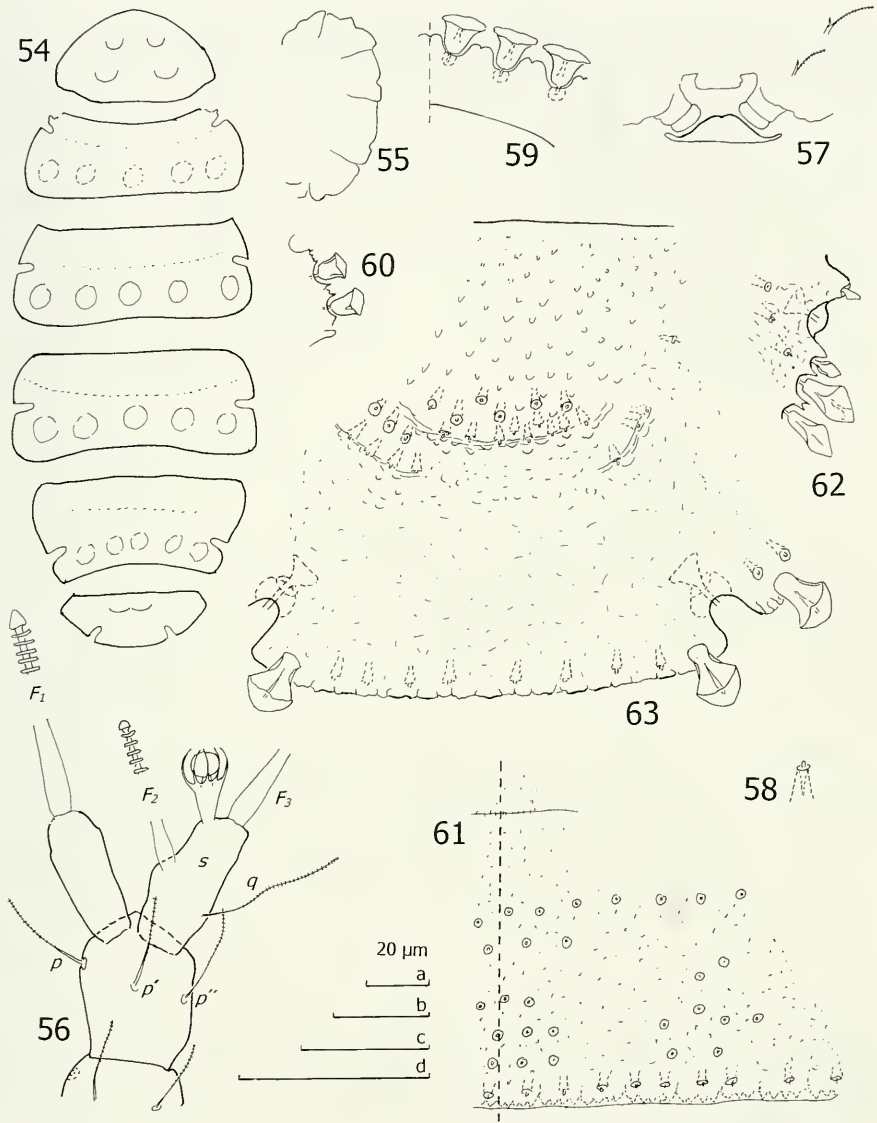
*Etymology.* From Latin ternarius = consisting of three (referring to the three digitiform appendages surrounding each genital papilla).

#### DESCRIPTION

*Length.* (0.62-)0.87 mm.

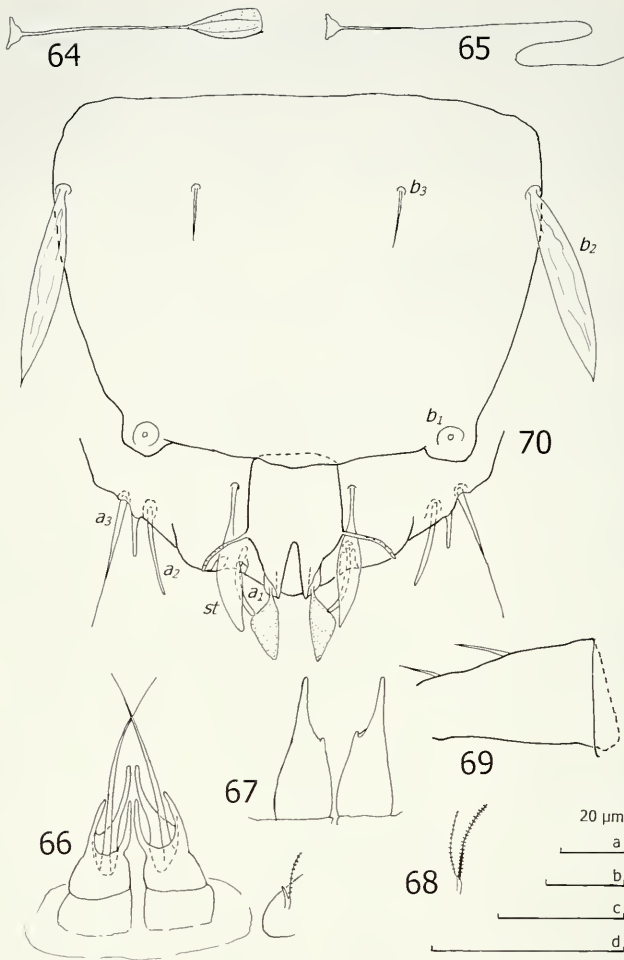
*Head.* Setae hidden.

*Antennae.* Antennae glabrous; chaetotaxy of segments 1-4:  $2/2/2+g'/3$ ; setae very thin tapering, striate-annulate, their lengths on segment 4:  $p = ?(12-13)$ ,  $p' = 9(-14)$ ,  $p'' = 8(-13)$   $\mu\text{m}$ ; no  $p'''$ ,  $u$  and  $r$ . Sternal branch subcylindrical but with anterior truncation, anterior margin = 7(-8), posterior margin = 15(-18),  $\emptyset$  of base = 5(-6), maximum  $\emptyset = 7(-9)$ ,  $q$  thin tapering cylindrical annulate-striate,  $l = 15(-16)$   $\mu\text{m}$ . Posterior margin/length of  $g$  1.9(-2.2), posterior margin/maximum  $\emptyset = (1.8-)2.1(-2.5)$ , maximum  $\emptyset/\emptyset$  of base = (1.3-)1.4. Tergal branch subcylindrical, widest in distal half.



Figs 54-63

*Samarangopus ternarius* sp. n., holotype, ad. 9(♂). 54, body with tergites I-VI showing distribution of shallow depressions in the cuticle (marginal setae not illustrated); 55, body, lateral view showing the transversal ridges on the tergites; 56, left antenna, sternal view; 57, collum segment, median and left part, sternal view; 58, tube-like organ in the cuticle of the tergites; 59, tergite I, part of anterior margin, sternal view; 60, tergite I, left posterior corner, sternal view; 61, tergite II, posteromedian part; 62, tergite II, right anterolateral corner, sternal side; 63, tergite VI, median and posterior part. Scale a: Figs 60-62; b: Figs 57, 63; c: Fig. 59; d: Figs 56, 58.



FIGS 64-70

*Samarangopus ternarius* sp. n., 64-66, 68-70 holotype, ad. 9(♂), 67 subad. 8(♂). 64,  $T_3$ ; 65,  $T_4$ ; 66, genital papillae and seta on coxa of leg 2, anterior view; 67, genital papillae, subad 8, anterior view; 68, seta on trochanter of leg 9; 69, tarsus of leg 9; 70, pygidium, sternal view. Scale a: Fig. 66; b: Fig. 67; c: Figs 64, 65, 68, 69; d: Fig. 70.

$l = 14(-17)$ ,  $\text{\O}$  of base = 3, maximum  $\text{\O} = 6(-7)$   $\mu\text{m}$ : pore not ascertained; length of  $t/\text{maximum } \text{\O} = 2.3(-2.4)$ . Globulus  $g$ ,  $l = (7-)$ 8(-9), maximum  $\text{\O} = 5(-6)$   $\mu\text{m}$ ; length/maximum  $\text{\O} = 1.4 (-1.6)$ ; number of bracts (7-) $8(-9)$ , their length = (4-) $5$ . capsule spherical,  $\text{\O} = 3$   $\mu\text{m}$ . Relative lengths of flagella (base segments included):  $F_1 = 100$ ,  $F_2 = (40-)$ 43(-50),  $F_3 = 76(-83)$ . Lengths of base segments,  $bs_1 = (9-)$ 10,  $bs_2 = ?(5-6)$ ,  $bs_3 = 8(-9)$   $\mu\text{m}$ . The  $F_1$  (4.6-) $5.0$  times as long as  $t$ ,  $F_2$  and  $F_3$  (1.7-) $2.0(-2.2)$  and  $3.5(-3.7)$  times as long as  $s$  respectively. The  $F_2$  thinner than  $F_1$  and  $F_3$ . Calyces conical, those of  $F_2$  and  $F_3$  smaller than those of  $F_1$ .



*Trunk.* Setae of collum segment similar, furcate, main branch subcylindrical, tapering, striate, pointed; secondary branch rudimentary, pointed, glabrous, sublateral seta 1 = (12-)13, submedian seta 1 = 11(-12)  $\mu$ m. Sternite process low, rounded anteriorly and with a shallow anterior incision, appendages barrel-shaped, height of caps at least 1/3 of the length of appendage, no collar; collum segment glabrous.

*Tergites.* Tergites with transversal ridges and behind them a row of shallow depressions in the cuticle (figs 54, 55). Tergite VI with a central rounded bulge. The protuberances arranged in a single row on anterior and lateral margins of I, on lateral margins of II-V and on posterolateral margins of VI. Protuberances campanulate, symmetrical, short and broad on tergite I, longish and open on sternal side on lateral margins of II-V, probably folioform with distal part turned downwards on VI. Subcuticular subcylindrical structures with very small tube-like opening in the cuticle present.

Number of campanulate marginal protuberances: I, 27; II, 1 small —  $T_1$  — 1 small + 9-10; III, 1 small + 4 —  $T_2$  — 1 small + 6; IV, 1 small + (4-)5 —  $T_3$  — 1 small + 4; V, (6-)7 —  $T_4$  — 1 small + 3, VI, 6 —  $T_5$  — 1. Length/width ratio of tergites: I = 0.6, II = 0.3(-0.4), III = IV = V = 0.4(-0.5), VI = (0.4-)0.5(-0.6).

*Bothriotricha.* All bothriotricha but  $T_3$  curled distally and with very thin glabrous axes. The  $T_3$  with thicker axes and a spatulate end-swelling 2.4 times as long as its greatest width; end-swelling with minute pubescence, length of end-swelling 1/4 of the length of bothriotricha. Relative lengths of bothriotricha (some bothriotricha seemingly broken):  $T_1 = 100$ ,  $T_2 = (78-)100$ ,  $T_3 = (64-)80(-81)$ ,  $T_4 = 60(-127)$ ,  $T_5 = 62(-106)$ .

*Genital papillae.* Base segments in the shape of truncated cones, proportionately long. Length of papillae = (40-)45, greatest  $\emptyset = (17-)19$ , length of seta = 60(-72)  $\mu$ m. Papillae with a constriction in the middle around the sternally directed opening. Genital orifice very wide and surrounded by 3 digitiform appendages, two anterior ones only somewhat longer than proximal subcylindrical part of genital papilla and one much longer posterior appendage. Setae very long, proximal half thick, their length 1.3(-1.6) times as long as genital papillae. Papillae (2.3-)2.4 times as long as greatest diameter. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, length = 20  $\mu$ m.

*Legs.* All legs 5-segmented. Seta on coxa and trochanter of leg 9 subsimilar, furcate, branches tapering, pointed, striate; bases glabrous, length of secondary branch 0.8 of primary one. More anteriorly these setae with rudimentary pointed glabrous secondary branches. Tarsi short, tapering, those of leg 9 1.6(-2.0) times as long as their greatest diameter; two tergal setae, both pointed glabrous; length of proximal one 10(-12), distal one (6-)7  $\mu$ m. Proximal setae 0.3(-0.4) of the length of tarsus and (1.3-)1.4(-1.5) times as long as distal seta. Cuticle of tarsus glabrous. No proximal seta on tarsi of leg 1. All legs with large main claw and small setose anterior secondary claw; in leg 9 the former reaching 0.5(-0.6) of the length of tarsus. On anterior side of femur of leg 1 a blunt, shortly pubescent appendage, length = 5  $\mu$ m.

*Pygidium. Tergum.* Posterior margin divided into 3 lobes, the median one between  $a_1$  rounded posteriorly. Outside these lobes, between  $a_2$  and  $a_3$ , a posteriorly directed narrow and digitiform appendage present, its length almost that of  $a_1$ . Setae

glabrous,  $a_1$  and  $a_2$  cylindrical, blunt, curved inwards and somewhat converging,  $a_3$  straight, tapering, pointed, diverging,  $st$  in the shape of a straight, narrow, stalked, lanceolate, pointed leaf. Lengths of setae:  $a_1 = (6-7)$ ,  $a_2 = (8-9)$ ,  $a_3 = (13-14)(-15)$ ,  $st = (12)15 \mu\text{m}$ . Distance  $a_1 - a_1 = (10-11)$ ,  $a_2 - a_2 = 27(-29)$ ,  $a_3 - a_3 (33-35)$ ,  $a_1 - a_2 = (8-10)$ ,  $a_2 - a_3 = 5$ ,  $st - st = (11-12) 12 \mu\text{m}$ . Distance  $a_1 - a_1$  1.6(-1.8) times as long as  $a_1$ , distance  $a_1 - a_2$  (1.6-)2.0 times longer than distance  $a_2 - a_3$ ; distance  $st - st$  0.8(-0.9) of the length of  $st$  and (1.0-) 1.1 times as long as distance  $a_1 - a_1$ . Cuticle glabrous.

*Sternum*. Posterior margin with low triangular bulge below anal plate; posterolateral corners lobate around insertion points of  $b_1$ . The  $b_1$  not studied in the holotype, in paratypes subcylindrical, striate distally;  $b_2$  very broad, lanceolate, with transparent wings;  $b_3$  very thin, glabrous, pointed. Lengths of setae:  $b_1 = ? (30-34)$ ,  $b_2 = (19-20)$ ,  $b_3 = 7(-11) \mu\text{m}$ . Distance  $b_1 - b_1 = (31-32)(-33)$ ,  $b_2 - b_2 = (47-49)$ ,  $b_3 - b_3 = (20-21)(-23)$ ,  $b_1 - b_2 = (25-26)$ ,  $b_2 - b_3 = (12-13) \mu\text{m}$ . Distance  $b_1 - b_1$  ?(0.8-0.9) of the length of  $b_1$ ,  $b_2$  0.8 of distance  $b_1 - b_2$ ,  $b_3$  0.4(-0.5) of the distance  $b_3 - b_3$ .

Anal plate 1.5 times as long as broad, widest in the middle, lateral margins almost straight with rounded lateral corners just behind the middle; from the posterolateral corners two thin, cylindrical, distally somewhat curved appendages protruding outwards-backwards at almost right angles; distal part of plate divided by a V-shaped incision into two subcylindrical branches; each branch cut squarely and provided with two appendages: a submedian short straight glabrous one and a stalked bladder of triangular shape in sternal view. Bladder-shaped appendages 0.5 of the length of plate. Plate glabrous, lateral appendages indistinctly striate, bladder-shaped appendages minutely pubescent.

*Stage snbad*. 8. Number of campanulate marginal protuberances: I, ?; II, 1 small —  $T_1$  — 1 small + 8; III, 1 small + 4 —  $T_2$  — 1 small + 5; IV, 5 —  $T_3$  — 1 small + 3; VI, 6 —  $T_5$  — 3.

*Genital papillae* with two appendages, one long digitiform and the other very short, no seta present. Setae  $b_2$  on pygidial sternum not lanceolate.

*Stage jiv*. 6. Number of campanulate marginal protuberances: I, 23; II, 0 or 1 —  $T_1$  — 1 small + 7; III, 4 —  $T_2$  — 4 or 5; IV, 5 —  $T_3$  — 3; VI, 4 —  $T_5$  — 1. Setae  $b_2$  on pygidial sternum not lanceolate.

*Stage juv* 5. Number of campanulate marginal protuberances: I, 21; II, 1 —  $T_1$  — 7; III, 4 —  $T_2$  — 4; VI, 4 —  $T_5$  — 1. Setae  $b_2$  on pygidial sternum not lanceolate.

### *Samarangopus proekes* sp. n.

Figs 71-91

*Type material*. **Holotype**: ad. 9(♀), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, Berlese extraction. 10.V.1982 (Loc. Sab-82/41). **Paratype**: ad. 9(♂), same locality and date as for the holotype.

*Total number*. 2 specimens.

*Diagnosis*. The genus *Samarangopus* seems to be morphologically heterogeneous as to the cuticular structures of the tergites. The great variation in the characters of the tergites is evident from the enlarged anterolateral corners of tergite II and the structure of both the cushion-like organs and the rod-like lateral protuberances of the tergites in *S. proekes* sp. n.. None of these characters has been observed in other

species. Its isolation in relation to other species is underlined by the almost cylindrical shape of the appendages of the collum segment and the very long slender claws. The relationships of *S. proekes* sp. n. cannot be traced at present.

*Etymology.* From Greek proekes = pointed in front (referring to the shape of tergite II).

#### DESCRIPTION

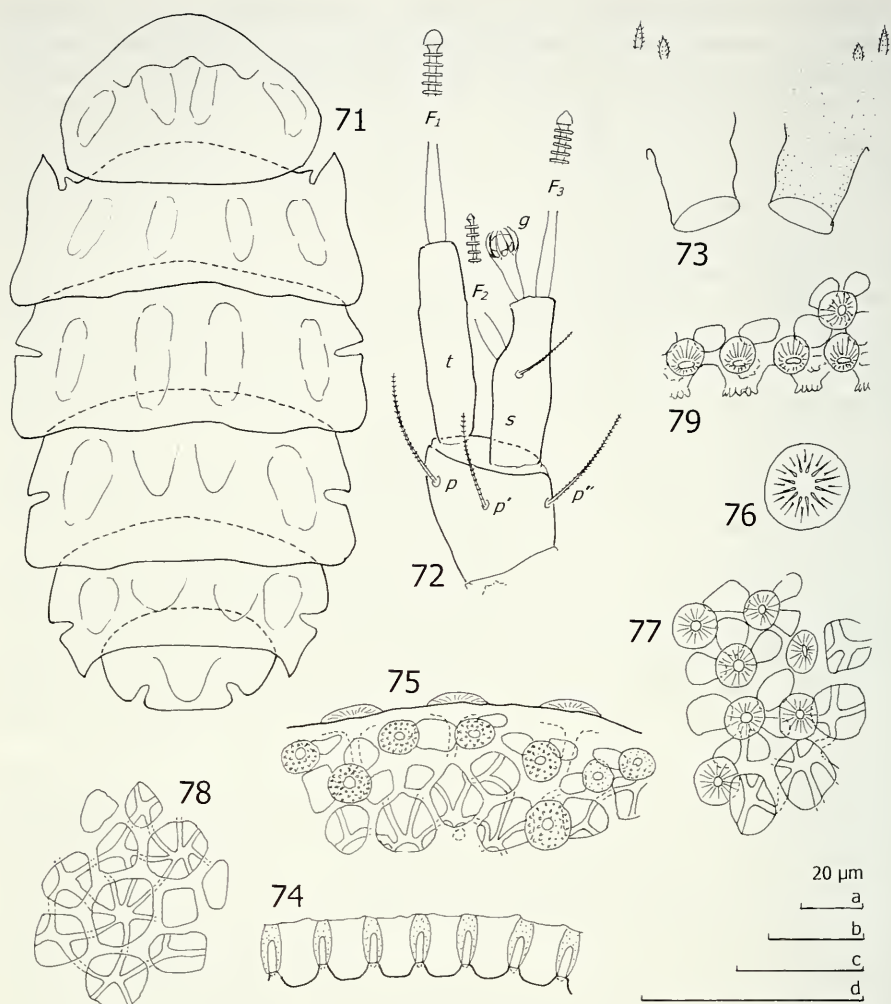
*Length.* (0.90-)1.11 mm.

*Head.* Setae hidden.

*Antennae.* Antennae glabrous; chaetotaxy of segments 1-4: 2/2/2 +g'/3; setae thin, tapering, pointed, with short oblique pubescence, their lengths on segment 4:  $p = (22)24$ ,  $p' = 22$ ,  $p'' = 25 \mu\text{m}$ ; no  $p'''$ ,  $u$  and  $r$ . Sternal branch subcylindrical but with distinct anterior truncation, anterior margin = 20, posterior margin = 34,  $\emptyset$  of base = 10, maximum  $\emptyset = 12(13)$ ,  $q$  as setae on segment 4,  $l = (12)15 \mu\text{m}$ . Posterior margin/length of  $g = 2.2(2.8)$ , posterior margin/maximum  $\emptyset = (2.6)2.8$ , maximum  $\emptyset/\emptyset$  of base = 2.4(2.6). Tergal branch subcylindrical, widest in the middle,  $l = (33)41$ ,  $\emptyset$  of base = 3, maximum  $\emptyset = (9)10 \mu\text{m}$ ; pore not ascertained; length of  $t/\text{maximum } \emptyset = (3.7)4.1$ . Globulus  $g$ ,  $l = (12)15$ , maximum  $\emptyset = (7)8 \mu\text{m}$ ; length/maximum  $\emptyset = (1.7)1.9$ ; number of bracts 12, their length = 3, capsule somewhat flattened,  $\emptyset = 4 \mu\text{m}$ . Relative lengths of flagella (base segments included):  $F_1 = 100$ ,  $F_2 = 39(44)$ ,  $F_3 = 75(86)$ . Lengths of base segments,  $bs_1 = (20)21$ ,  $bs_2 = 10$ ,  $bs_3 = (17)18 \mu\text{m}$ . The  $F_1$  3.5(3.7) times as long as  $t$ ,  $F_2$  and  $F_3$  1.6 and (3.1)3.2 times as long as  $s$  respectively. The  $F_2$  thinner than  $F_1$  and  $F_3$ . Calyces of  $F_1$  subhemispherical, those of  $F_2$  and  $F_3$  subconical.

*Trunk.* Setae of collum segment similar to each other, short, simple, subconical-lanceolate, pointed, with dense short oblique pubescence; submedian setae  $l = 5$ , sublateral setae  $l = 6 \mu\text{m}$ . Sternite process not studied. Appendages cylindrical, with very short dense pubescence, caps flat and glabrous.

*Tergites.* Tergites I-V each with 4 oval depressions in a transversal row (fig. 71), tergite VI with posterolateral depressions; depressions on I-V with bare bottom, surrounded by raised cuticle. Posterior margins of anterior tergites serrate with teeth in small groups separated by V- or U-shaped incisions. Tergite II with large pointed lobes just behind the insertion pit of  $T_1$ ; lobes directed anteriorly, triangular, longer than broad. Raised cuticle with complicated surface: 1. round transparent cushion-like structures,  $\emptyset = 10-15 \mu\text{m}$ , with a central vertical hole narrowing downwards and being surrounded by about 20 radiating canals widest in inner part (fig. 76); 2. deep cavities with steep inner walls, opening rounded or angular with rounded corners (figs 75, 77, 78), through the bottom a wide network of large canals most often with the junctions below the bottom of the cavities visible. Oval depressions of tergites only with cavities. Anterior and lateral margins of tergite I, lateral margins of II-V and posterior margin and posterolateral corners of VI with a single row of fusiform rods coated by a likewise fusiform, somewhat transparent, granular capsule; rods with capsules joined by a thin and transparent membrane (fig. 74). Number of rod-like marginal protuberances: I, 41(42); II, 1 small (0) —  $T_1$  — 1 small + 15(16); III, 7 + 1

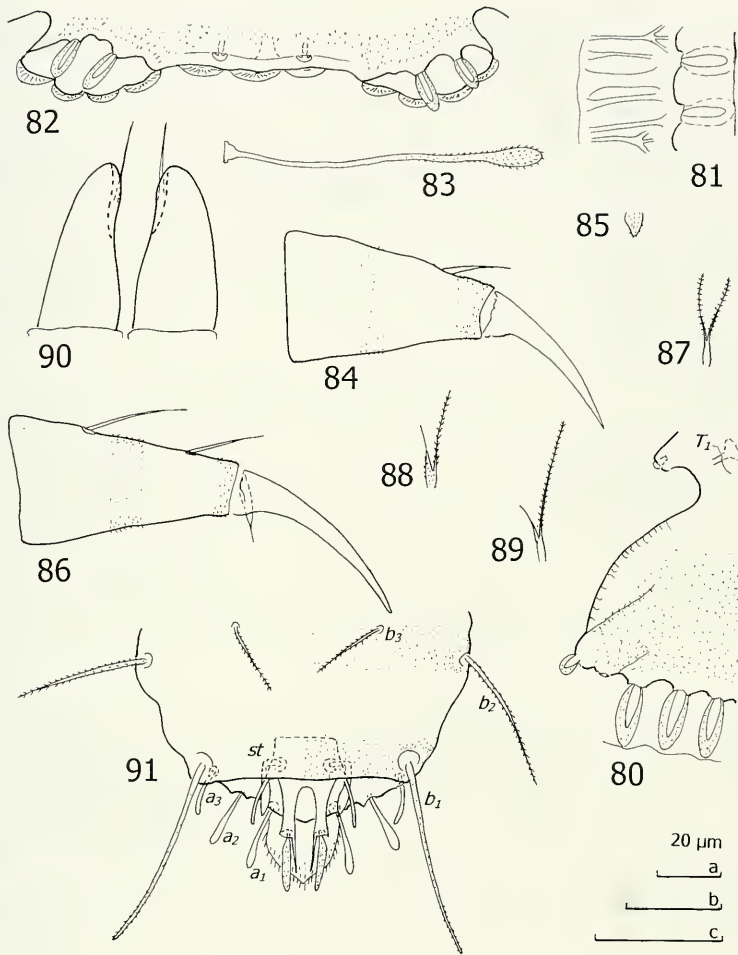


Figs 71-79

*Samarangopus proekes* sp. n., holotype, ad. 9(♀). 71. body with tergites I-VI showing distribution of shallow depressions in the cuticle (marginal setae not illustrated); 72. left antenna, sternal view; 73. collum segment, appendages and setae; 74. tergite I, anterior margin, sternal view; 75. tergite I, anterior part, tergal view; 76. tergite I, cushion-like structure, tergal view; 77. tergite I, central part between depressions; 78. tergite I, central part, bottom of depression; 79. tergite I, posterior margin. Pubescence only partly drawn in 73. Scale: a: Figs 77-79; b: Figs 72-74; c: Fig. 75; d: Fig. 76.

small —  $T_2$  — 1 small + 7 (+ 1 small); IV, 8 —  $T_3$  — 7; V, (8)9 —  $T_4$  — 5 + 1(0) small; VI, (6)7 —  $T_5$  — 2. Length/width ratio of tergites: I = 0.6, II = (0.3)0.4, III = IV = (0.4)0.5, V = 0.5, VI = (0.4)0.6.

*Bothriotricha*. All bothriotricha but  $T_3$  with very thin axes, these glabrous except for a minute pubescence in their distal 1/5. The  $T_3$  with thicker axes and outer



FIGS 80-91

*Samarangopus proekes* sp. n., 80-89, 91 holotype, ad. 9 (♀), 90 paratype, ad. 9 (♂). 80, tergite II, right anterolateral corner with insertion pit of  $T_1$ ; 81, tergite II, lateral margin with fusiform protuberances, sternal view; 82, tergite VI, posteromedian part, sternal view; 83,  $T_3$ ; 84, tarsus of leg 1; 85, appendage on femur of leg 1; 86, tarsus of leg 9; 87, seta on trochanter of leg 9; 88, seta on coxa of leg 5; 89, seta on trochanter of leg 5; 90, genital papillae, anterior view; 91, pygidium, sternal view. Pubescence only partly drawn in 84, 86, 91. Scale a: Figs 80-82, 90; b: Figs 84-89, 91; c: Fig. 83.

fourth increasing in width forming a distal clavate end-swelling, 2.5 times as long as wide;  $T_3$  with short oblique pubescence on distal half. Relative lengths of bothriotricha (holotype only):  $T_1 = 100$ ,  $T_2 = 100$ ,  $T_3 = 45$ ,  $T_4 \approx 100$ ,  $T_5 = 73$ .

*Genital papillae* (paratype). Base segments short, papillae somewhat tapering with rounded tip. Length of papillae = 52, greatest  $\varnothing = 25$ , length of seta = 25  $\mu\text{m}$ ; length/ $\varnothing = 2.1$ , setae 0.5 of the length of papillae. Cuticle glabrous.

*Legs.* All legs 5-segmented. Setae on coxa and trochanter of leg 9 similar to each other, furcate, with branches of the same length, pointed, striate. More anteriorly these setae being longer, especially on trochanter, with rudimentary pointed secondary branches. Primary branch on coxa of leg 5 twice longer than secondary one, on trochanter 3.8 times as long as secondary branch. Tarsi short, strongly tapering, those of leg 9 1.8(1.9) times as long as their greatest diameter; two tergal setae, both pointed and glabrous; length of proximal one 21(24)  $\mu\text{m}$ , distal one (12)16  $\mu\text{m}$ . Proximal setae 0.4(0.5) of the length of tarsus and 1.3 times as long as distal seta. Cuticle of tarsus with short pubescence. No proximal seta on tarsus of leg 1. All legs with large main claw and small setose anterior secondary claw; in leg 9 the former reaches almost 0.9 of the length of tarsus. On anterior side of femur of leg 1 a linguiform appendage with short pubescence,  $l = 5 \mu\text{m}$ .

*Pygidium. Tergum.* Posterior part broadly triangular and with large postero-medial plate; the latter 1.1 times as long as broad, leaf-shaped, posterior end pointed, distal and lateral parts with distinct oblique pubescence. No posterolateral digitiform appendages. The  $a_1$  and  $a_2$  clavate, with very short pubescence distally, diverging;  $a_3$  subcylindrical, glabrous, curved inwards and somewhat diverging; *st* knife-like, with knee-like flexure near base, glabrous. Lengths of setae:  $a_1 = 14$ ,  $a_2 = 13$ ,  $a_3 = 9(10)$ ,  $st = 10 \mu\text{m}$ . Distance  $a_1 - a_1 = (12)13$ ,  $a_2 - a_2 = (26)27$ ,  $a_3 - a_3 = (38)39$ ,  $a_1 - a_2 = 7$ ,  $a_2 - a_3 = (7)8$ ,  $st - st = (9)10 \mu\text{m}$ . Distance  $a_1 - a_1$  0.9 of the length of  $a_1$ , distance  $a_1 - a_2$  about as long as distance  $a_2 - a_3$ , distance  $st - st$  about 0.8 of distance  $a_1 - a_1$ . Cuticle glabrous.

*Sternum.* Posterior margin straight. Setae thin, tapering,  $b_1$  blunt,  $b_2$  and  $b_3$  pointed;  $b_1$  with very short pubescence, diverging;  $b_2$  and  $b_3$  with distinct oblique pubescence, the former diverging and the latter converging. Lengths of setae:  $b_1 = 43$ ,  $b_2 = 30$ ,  $b_3 = (15)16 \mu\text{m}$ . Distance  $b_1 - b_1 = (42)43$ ,  $b_2 - b_2 = 66$ ,  $b_3 - b_3 = (24)30$ ,  $b_1 - b_2 = (24)25$ ,  $b_2 - b_3 = (18)20 \mu\text{m}$ . Distance  $b_1 - b_1$  as long as the length of  $b_1$ ,  $b_2$  1.2 times as long as distance  $b_1 - b_2$ ,  $b_3$  0.5(0.6) of the distance  $b_3 - b_3$ .

Anal plate 2.3(2.4) times as long as broad, widest in anterior third; broadest part with evenly rounded margins, two thin, cylindrical, blunt, appendages protrude obliquely backwards from it; appendages 0.3 of the length of plate; posterior 3/5 of plate divided by a U-shaped incision into two branches, these somewhat narrower in the middle than posteriorly; each branch cut squarely and provided with two appendages: a submedian straight glabrous pointed one and a stalked narrow fusiform bladder. Bladders 0.4 of the length of plate. Plate glabrous, appendages with minute pubescence. Sternum with short pubescence.

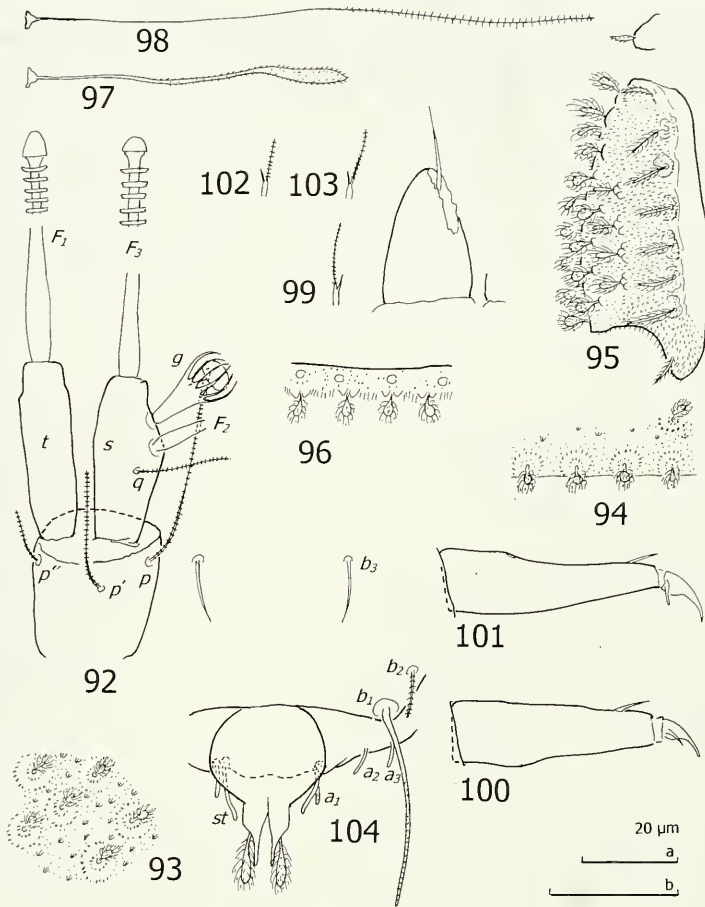
Genus *Sphaeropauropus* Silvestri, 1930

*Sphaeropauropus penicillius* sp. n.

Figs 92-104

*Type material. Holotype:* ad. 9(♂), SABAH, Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", lowland dipterocarp forest near "Orang-Utan Rehabilitation Station", sifting of litter from between buttresses of large trees, Winkler-Moczarski extraction, 3.V.1982 (Loc. Sab-82/27). *Paratypes:* 2 subad. 8(♀), 1 juv. 6, same locality and date as for the holotype.

*Total number.* 4 specimens.



FIGS 92-104

*Sphaeropauropus penicillius* sp. n., holotype, ad. 9( $\delta$ ). 92, right antenna, anterior view; 93, tergite I, central part; 94, tergite I, posteromedian margin; 95, tergite II, right laterosternal furrow, sternal view; 96, tergite VI, posteromedian margin, sternal view; 97,  $T_3$ ; 98,  $T_5$ ; 99, left genital papilla and seta on coxa of leg 2; 100, tarsus of leg 1; 101, tarsus of leg 9; 102, seta on coxa of leg 9; 103, seta on trochanter of leg 9; 104, pygidium, median and left part, sternal view. Scale a: Figs 93-96, 99-103; b: Figs 92, 97, 98, 104.

**Diagnosis.** *S. penicillius* sp. n. is in most characters very close to *S. malayus* Silvestri from Java (Silvestri, 1930) but is easily distinguished from that species by the shape of the endswelling of the bothriotrix  $T_3$  (>6 times as long as wide in *S. penicillius* sp. n.,  $\approx 2$  in *S. malayus*) and the claws (distinctly curved in *S. penicillius* sp. n., almost straight in *S. malayus*). Relationships may be traced also with *S. martensi* Scheller and *S. breviglobulatus* Scheller, both described from Nepal (Scheller, 2000). There are similarities especially in the shape of the end-swelling of the bothriotrix  $T_3$ . Good distinctive characters are the shape of the tuft-like setae, e.g.,

on the central part of tergite I, a distinctly clavate stalk and proportionately long hairs in *S. penicillius* sp. n., versus a somewhat clavate stalk and proportionately short hairs in *S. martensi* and *S. breviglobulatus*. The new species is, besides dissimilarities in the details of the pubescence of the tergites, distinguished from *S. martensi* by the shape of the anal plate (distal appendages with pointed inner lengthening in *S. penicillius* sp. n., not short, broadly triangular, submedian) and from *S. breviglobulatus* by the shape of the antennal globulus *g* (wider than tergal branch *t* in *S. breviglobulatus*, not so in *S. penicillius* sp. n.).

*Etymology.* From Latin penicillus, penicillum = brush (referring to the setae on the tergites).

#### DESCRIPTION

*Length.* 0.65 mm.

*Head.* Head and temporal organ hidden behind the antennae and not studied.

*Antennae.* Antennae glabrous. Chaetotaxy of segments 1-4: 2/2/2+?g'/3. Setae subcylindrical, annulate-striate, their lengths on segment 4:  $p = 33$ ,  $p' = 19$ ,  $p'' = 10$   $\mu\text{m}$ . Sternal branch with distinct anterodistal truncation, anterior margin = 15, posterior margin 25,  $\emptyset$  of base = 6, maximum  $\emptyset = 11$ ,  $\emptyset$  of top = 7,  $q = 15$   $\mu\text{m}$ . Anterior margin/length of *g* 1.1; posterior margin/length of *q* = 1.7; anterior margin/posterior margin = 0.6; posterior margin/maximum  $\emptyset = 2.3$ ; maximum  $\emptyset/\emptyset$  of base = 1.8. Tergal branch *t* somewhat fusiform, length = 28,  $\emptyset$  of base = 5, maximum  $\emptyset = 8.5$   $\mu\text{m}$ , length of *t*/maximum  $\emptyset = 3.3$ . Globulus *g* almost straight, stalk conical, length of *g* = 14, maximum  $\emptyset = 7.5$   $\mu\text{m}$ ; 9 bracts, their length = 6  $\mu\text{m}$ ; capsule with flattened bottom, length = 3,  $\emptyset = 5$   $\mu\text{m}$ . Relative lengths of flagella (base segments included):  $F_1 = 100$ ,  $F_2 = 44$ ,  $F_3 = 61$ . Length of base segments:  $bs_1 = 21$ ,  $bs_2 = 8$ ,  $bs_3 = 17$   $\mu\text{m}$ . The  $F_1$  3.1 times as long as *t*,  $F_2$  and  $F_3$  1.6 and 2.2 times as long as *s* respectively. Calyces of  $F_1$  largest, conical, those of  $F_2$  and  $F_3$  subhemispherical.

*Trunk.* Collum segment hidden, not studied. Tergal sides of tergites with tuft-like setae, those on anterior part of tergite I broadly clavate, ovoid, with subcylindrical stalk, those on posteromedian part clavate. Cuticle between tuft-like setae with short but distinct pubescence, hairs partly arranged in dense groups forming scattered small sessile organs of candelaber-like shape: pubescence longest on lateral parts of tergites. Around each tuft-like seta two whorls of short hairs with a glabrous area in between.

The laterosternal furrows of the tergites with tuft-like setae on both margins, setae clavate on outer margin but thin subcylindrical blunt or pointed on inner margin.

*Bothriotricha.* All bothriotricha with simple axes; all but  $T_3$  very thin, with sparse short and mostly erect pubescence of straight hairs. The  $T_3$  with thicker axes and distal fusiform somewhat pointed swelling, its length almost 1/3 of the length of bothriotrix, distal 2/3 of  $T_3$  covered with a short dense pubescence of oblique hairs. Relative lengths of bothriotricha:  $T_1 = 100$ ,  $T_2 = 95$ ,  $T_3 = 56$ ,  $T_4 = 73$ ,  $T_5 = 58$ .

*Genital papillae.* Base segments short, length of papillae = 30, greatest  $\emptyset = 19$ , length of seta = 18  $\mu\text{m}$ . Papillae conical with rounded tip, 1.6 times as long as greatest diameter, seta 0.6 of the length of papilla. Cuticle glabrous. Coxal seta of leg 2 as on leg 1, length = 18  $\mu\text{m}$ .



*Legs.* All legs 5-segmented. Setae on coxa and trochanter of leg 9 subsimilar, furcate, primary branch tapering, pointed, annulate; secondary branch rudimentary, pointed, glabrous, seta on coxa  $l = 12$ , on trochanter  $l = 15 \mu\text{m}$ . Secondary branches of these setae on more anterior legs similar to each other but primary branches longer.

Tarsi of leg 9 slender, tapering, 3.3 times as long as greatest diameter, minutely pubescent most distally; two tergal setae, both tapering, pointed, glabrous, proximal one = ?, distal one  $6 \mu\text{m}$ . No proximal seta on tarsus of leg 1. A short lanceolate glabrous appendage ( $l = 7 \mu\text{m}$ ) on anterior side of femur of leg 1.

Main claw of all legs thin, weakly curved; anterior secondary claw small, setose. In leg 1 main claw = 18, secondary claw =  $7 \mu\text{m}$ , in leg 9 main claw = 21, secondary claw =  $8 \mu\text{m}$ , main claw 0.3 of the length of tarsus in all legs. On anterior side of femur of leg 1 a disciform, triangular, blunt, appendage with short pubescence, length = 4(-5)  $\mu\text{m}$ . Cuticle of tarsi faintly pubescent.

*Pygidium. Tergum.* Setae almost uniform, cylindrical, blunt, with short oblique pubescence,  $a_1$ ,  $a_2$  and  $a_3$  somewhat curved inwards,  $a_1$  also converging, *st* somewhat S-shaped. Index of tergal setae:  $a_1 = (8-)$ 9,  $a_2 = (9-)$ 10,  $a_3 = (9-)$ 10(-11);  $a_1 - a_1 = (18-)$ 22 (-23),  $a_2 - a_2 = (22-)$ 24(26);  $a_3 - a_3 = (54-)$ 58(-63), *st* = (12-) $14$ , *st* - *st* = (17-) $20$ (-21)  $\mu\text{m}$ ; *st* - *st*/ $a_1 - a_1 = (0.8-)$ 1.0,  $a_1/a_1 - a_1 = 0.4$ (-0.5),  $a_1/a_1 - a_2 = 0.8$ (-1.0),  $a_1 - a_1/a_2 - a_3 = (3.0-)$ 3.7. Posteromedian part of tergum with short pubescence.

*Sternum.* Posterior margin between  $b^1$  somewhat convex, posterolateral lobes at the insertion points of  $b_1$  small; setae thin, tapering, pointed, with short oblique pubescence or striate. Index of sternal setae:  $b_1 = (42-)$ 47(-50),  $b_2 = (14-)$ 15(-19),  $b_3 = (17-)$ 25,  $b_1 - b_1 = (40-)$ 51(-53),  $b_2 - b_2 = (61-)$ 73(-76),  $b_3 - b_3 = (40-)$ 43(45),  $b_1 - b_2 = (12-)$ 15  $\mu\text{m}$ ,  $b_1/b_1 - b_1 = (1.1-)$ 1.3,  $b_1/b_2 = (2.4-)$ 3.1,  $b_2/b_1 - b_2 = 1.0$ (-1.6),  $b_3/b_3 - b_3 = (0.5-)$ 0.6(-0.7).

Anal plate almost circular and with two short subcylindrical branches protruding backward from posterior part of sternal side; branches separated by a narrow V-shaped incision and with posterolateral truncations on sternal side and with two distal appendages: a submedian tapering one and a median clavate one. The latter (3.1-) $3.2$ (-3.3) times as long as its greatest width and 1/4 of the length of the plate. Plate glabrous; clavate appendages with distinct pubescence of curved hairs.

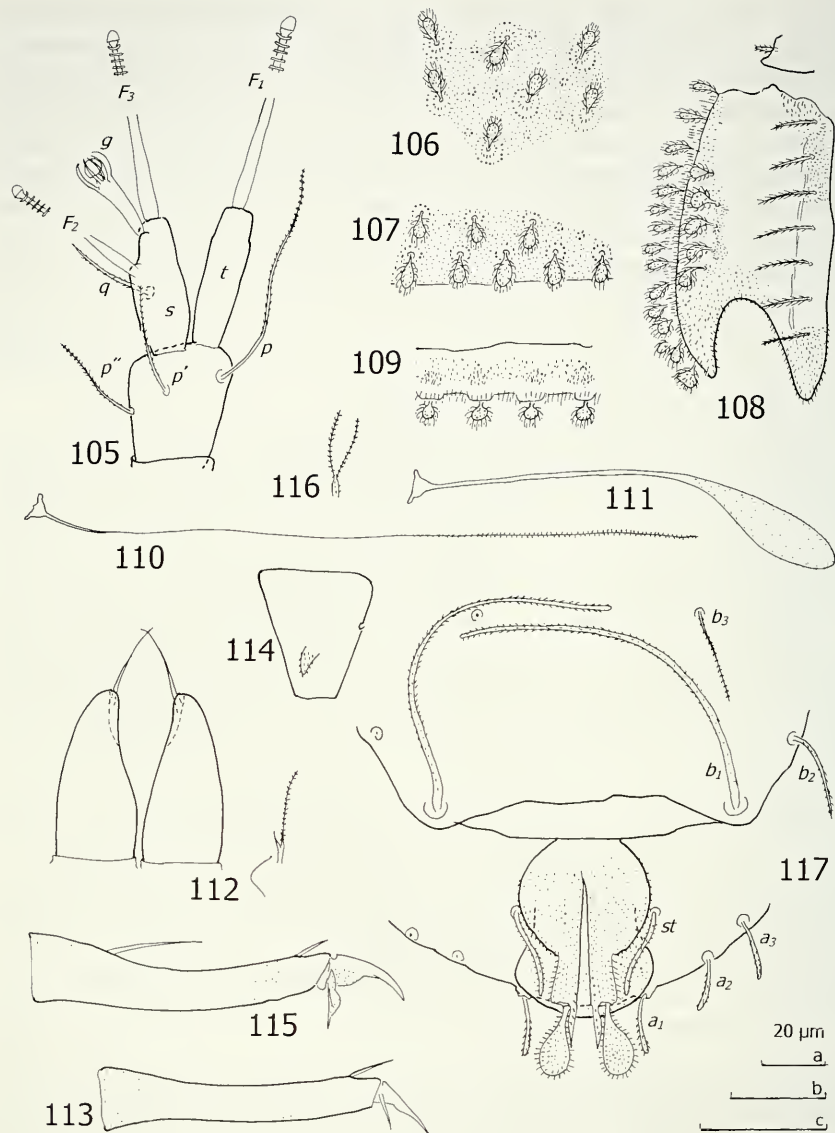
*Sphaeropaupopus arcuatus* sp. n.

Figs 105-117

*Type material. Holotype:* ad. 9(♀), SABAH, Interior Residency, road to Kimanis, 26 km from Keningau, helicopter port, sifting in cloud forest, alt. 1380 m. Berlese extraction, 12.V.1982 (Loc. Sab-82/43b). *Paratypes:* 1 ad. 9(♀), same locality and date as for the holotype, Winkler-Moczarski extraction (Loc. Sab-82/43a); 1 ad. 9(♀), SABAH, Sandakan Residency, 24 km W Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest near "Pond", sifting of litter and dead wood, Winkler-Moczarski extraction, 23.IV.1982 (Loc. Sab-82/7).

*Other material.* SABAH, West Coast Residency, Mount Kinabalu, "Bukit Ular Trail" (path between "Kambarangan Road" and "Power Station"), 1850 m, litter from *Lithocarpus-Castanopsis* forest, 1 ad. 9(♂), 28.IV.1982, Berlese extraction (Loc. Sab-82/16); *ibidem*, sample from near foot of large tree, Berlese extraction, 1 subad. 8(♀), 1 juv. stad.?, 28.IV.1982 (Loc. Sab-82/17). Sandakan Residency, 24 km W of Sandakan, Sepilok, "Kabili-Sepilok Forest Reserve", secondary lowland forest close to "Pond", litter sample, 1 ad. 9(♀), 10.V.1982, Berlese extraction (Loc. Sab-82/42).

*Total number.* 7 specimens.



Figs 105-117

*Sphaeropauropus arcuatus* sp. n., 105-111, 113-117 holotype ad. 9(♀), 112, paratype, ad. 9(♂), 105, right antenna, sternal view; 106, tergite I, central part; 107, tergite I, posteromedian margin; 108, tergite II, right laterosternal furrow, sternal view; 109, tergite VI, posteromedian margin, sternal view; 110,  $T_1$ ; 111,  $T_3$ ; 112, genital papillae and seta on coxa of right leg 2, anterior view; 113, tarsus of leg 1; 114, appendage on femur of leg 1; 115, tarsus of leg 9; 116, seta on coxa of leg 9; 117, pygidium, sternal view. Pubescence only partly drawn in 108, 113, 115. Scale a: Figs 105, 108, 110, 112-115; b: Figs 106, 107, 109, 111, 116; c: Fig. 117.

*Diagnosis.* The new species shows close affinities to *S. penicillius* sp. n. but is distinguished from it by the shape of the stalk of the antennal globulus *g* (subcylindrical, not distinctly conical), the genital papillae (longer and curved inwards distally, not short and straight), the setae on coxa and trochanter of leg 9 (secondary branch well developed, not rudimentary), the  $T_3$  (end-swelling <4 times as long as wide, not >5), the setae on the pygidial tergum (distinctly pubescent, not glabrous), by the proportion  $b_1/b_1 - b_1$  ( $b_1$  longer than their distance apart, not shorter) and by the dimensions of the bladder-shaped appendages of the anal plate (<3 times longer than wide, not  $\approx$  5).

*Etymology.* From Latin *arcuatus* = shaped like a bow (referring to the bent tarsi on leg 9).

#### DESCRIPTION

*Length.* (0.89-)1.05 mm.

*Head.* Head setae hidden, not studied.

*Antennae.* Antennae glabrous. Chaetotaxy of segments 1-4: 2/2/2+g'/3. Setae subcylindrical, tapering, pointed, annulate, their lengths on segment 4:  $p = (55-)/76$ ,  $p' = (36)45$ ,  $p'' = (27-)/34$   $\mu\text{m}$ . Sternal branch with distinct anterodistal truncation, anterior margin = (23-)25, posterior margin = (40-)42,  $\emptyset$  of base = (10-)11, maximum  $\emptyset = 17$ ,  $q = (28-)/31$   $\mu\text{m}$ . Posterior margin/length of  $g = 1.4$  and  $1.5(-2.1)$ ; posterior margin/length of  $q = (1.2-)/1.4$ ; anterior margin/posterior margin =  $0.6(-0.7)$ ; posterior margin/maximum  $\emptyset = (2.2-)/2.5$ ; maximum  $\emptyset/\emptyset$  of base =  $1.5(-1.7)$ . Tergal branch  $t$  somewhat fusiform, length = (40-)44,  $\emptyset$  of base = 8, maximum  $\emptyset = (11-)/12$   $\mu\text{m}$ , length of  $t/\text{maximum } \emptyset = 3.5 (-3.6)$ . Globulus  $g$  somewhat curved with slender stalk, length of  $g = (22-)/27$  and 30, maximum  $\emptyset = (10-)/11$   $\mu\text{m}$ ; 9(-10) bracts, their length = 7-9  $\mu\text{m}$ ; capsule somewhat flattened, its stalk widened in its upper part, length of capsule = 5,  $\emptyset = 6$   $\mu\text{m}$ . Relative lengths of flagella (base segments included):  $F_1 = 100$ ,  $F_2 = 57(-67)$ ,  $F_3 = (87-)/99$ . Length of base segments:  $bs_1 = (28-)/36$ ,  $bs_2 = (13-)/16$ ,  $bs_3 = (24-)/33$   $\mu\text{m}$ . The  $F_3$  (3.1-)3.5 times as long as  $t$ ,  $F_2$  and  $F_3$  2.1(-2.2) and (2.9-)3.6 times as long as  $s$  respectively. Calyces subhemispherical, those of  $F_1$  largest, those of  $F_2$  smallest.

*Trunk.* Collum segment hidden, not studied.

Tergal sides of tergites with tuft-like setae, those on tergite I broadly clavate. Cuticle between tuft-like setae with dense and short pubescence, sparse just around the bases of the setae; small circular groups of dense pubescence hairs scattered between the setae. Setae almost globular at posterior margin of tergite VI.

The laterosternal furrows of the tergites with an inner row of subcylindrical tapering pointed setae with oblique pubescence hairs. Setae on outer margin tuft-like, with clavate stalk.

*Bothriotricha.* All bothriotricha with simple axes, all but  $T_3$  with very thin axes and short pubescence of straight erect hairs. The  $T_3$  with thick axes and distal ovoid swelling, its length 1/3 of the length of bothriotrix; distal part of  $T_3$  covered with a minute pubescence. Relative lengths of bothriotricha:  $T_1 = 100$ ,  $T_2 = (94-)/98(-109)$ ,  $T_3 = (39-)/45(-49)$ ,  $T_4 = (79-)/90$ ,  $T_5 = ?(60-85)$ .

*Genital papillae* (paratype). Papillae with short base segments,  $l = 55$ , greatest  $\emptyset = 25$ , seta  $l = 28 \mu\text{m}$ . Papillae 2.2 times as long as greatest diameter, seta 0.5 of the length of papillae. Cuticle glabrous. Coxal seta of leg 2 as on leg 1,  $l = 30 \mu\text{m}$ .

*Legs*. All legs 5-segmented. Setae on coxa and trochanter of leg 9 similar to each other, furcate, branches subequal, subcylindrical, blunt, pubescent-annulate,  $l = 20(-22) \mu\text{m}$ . More anteriorly these setae with rudimentary, pointed, glabrous secondary branches; primary branch there longer, e.g., on leg 3,  $l = 45 \mu\text{m}$ .

Tarsus of leg 9 slender, tapering, bow-bent, (4.1-)-4.3 times as long as its greatest diameter, minutely pubescent in the distal third; two tergal setae present, both tapering, pointed, glabrous, proximal one = (22-)-30, distal one (8-)-12  $\mu\text{m}$ , proximal seta 0.3 of the length of tarsus and (2.4-)-2.5(-2.6) times as long as distal seta. No proximal seta on tarsus of leg 1. A linguiform and pubescent appendage,  $l = 10 \mu\text{m}$ , on anterior side of femur of leg 1.

Main claw of leg 1 almost straight,  $l = (22-)-24(-25)$ , secondary claw seta-like,  $l = (12-)-13 \mu\text{m}$ ; on leg 9 main claw is curved,  $l = (26-)-27$ , secondary claw widened in the middle,  $l = (18)-20(-21) \mu\text{m}$ .

*Pygidium, Tergum*. Setae subsimilar, subcylindrical, blunt, with short oblique pubescence,  $a_1$  somewhat curved outwards,  $a_2$  and  $a_3$  somewhat inwards,  $a_3$  diverging, *st* weakly S-shaped. Index of tergal setae:  $a_1 = (8-)-9(-10)$ ,  $a_2 = 9(-10)$ ,  $a_3 = 10(-11)$ ;  $a_1 - a_1 = (17-)-19$ ,  $a_2 - a_2 = (37-)-39$ ;  $a_3 - a_3 = (48-)-52$ ,  $st = 14$ ,  $st - st = (20-)-21 \mu\text{m}$ .  $st - st/a_1 - a_1 = (1.0-)-1.1$ ,  $a_1/a_1 - a_1 = 0.5$ ,  $a_1/a_1 - a_2 = 0.2(-0.3)$ ,  $a_1 - a_1/a_2 - a_3 = 0.4$ . Posterosternal lobe of tergum with short pubescence.

*Sternum*. Setae  $b_1$  tapering and  $b_2$  subcylindrical, both with oblique pubescence,  $b_3$  cylindrical, striate. Index of sternal setae:  $b_1 = (54-)-60$ ,  $b_2 = b_3 = 15$ ,  $b_1 - b_1 = (42-)-47$ ,  $b_2 - b_2 = (60-)-65(-66)$ ,  $b_3 - b_3 = (29-)-35$ ,  $b_1 - b_2 = (12-)-15 \mu\text{m}$ ,  $b_1/b_1 - b_1 = 1.3$ ,  $b_1/b_2 = (3.6-)-4.0$ ,  $b_2/b_1 - b_2 = 0.3(-0.4)$ ,  $b_3/b_3 - b_3 = (0.4-)-0.6$ .

Anal plate circular and with two subcylindrical branches protruding backward from posterior part of sternal side; both branches separated by a deep narrow V-shaped incision; branches cut squarely and with two types of posterior appendages, an inner pointed and a submedian clavate one. The latter (2.1-)-2.3(-2.4) times as long as its greatest width and 1/3 of the length of the plate. Plate with dense pubescence being very short anteriorly, more distinct on posterior half, hairs longest and erect on clavate appendages.

## CONCLUSIONS

Up to now, two collections of pauropods have become available from north Borneo, together containing 99 specimens. Seven species were reported from the smaller collection (Scheller *et al.*, 1994) and 14 have been reported above. Because only one species was common (*Allopauropus proximus*), the pauropods seem to be very diversified on Borneo. This impression is strengthened by the high number of new species, 5 described in Scheller *et al.* (1994) and 9 above. Moreover, the insignificant presence of widely distributed species point in the same direction. Only three species belong there: *Allopauropus maortiorum* previously known from New

Caledonia, New Zealand and Chile, *A. bouini* from New Zealand, Angola and North America and *A. proximus* which is widespread of the tropics in Asia, Africa and South America.

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